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THE CAUSE AND CONTROL OF SEX IN HUMAN OFFSPRING

R. CLAY JACKSON

TACOMA, WASHINGTON
1926

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LOVINGLY DEDICATED

TO

MY FATHER AND MOTHER

BYRON AND CLARA JACKSON

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PRIMA VISTA

In all candor it ought not to be deemed outside the pale of conventionality or of ethics, that a layman should find it opportune to set forth, for the advancement of Science, and for the benefit of the race, a new category of facts on any problem whose resolution may seem thereby to be hastened.

In fact, it would manifestly be at the expense of good faith with our better selves if upon any occasion we encounter important clues to any obscure question in Science and fail thereupon to exert our best efforts towards the interpretation and application of that which has come to light.

In the effort undertaken I shall deal with the consideration of some facts and with the original discovery of some conclusive evidences which forced the formulation and application of a new hypothesis upon the riddle of Sex Determination, at least as related to the human species.

I have endeavored, so far as possible, to adapt the phraseology and the methods of reasoning to the requirements of all into whose hands the work may come, and despite what might seem at a cursory glance to be an involved discussion, yet in Chapter IX will be found a reduction of the "Law of Sex Determination" to a simple and concise form.

It is submitted that herein the food factor has been definitely separated from its hoary stronghold as a basic causative, and relegated to the status of merely a marginal or opportune relativity. Henceforward we may, in most cases, ignore it entirely, and in a certain quota of cases we shall, with increasing efficiency, learn to combine food manipulations with that of known basic factors to hasten results in Sex Control. It follows, therefore, that no serious disconcert will issue from leaving the food factor with most of its speculative phases to those who have, until now, ridden it to their hearts' content.

While the Professional and Technical world would not require any reference particularly to genetic or embryological functions, still I may say that in view of the general field which this work may reach, I have considered prudent the counsel of more than one friend, that the same would be fitting and welcome, and, accordingly, the standard and accepted findings in Genetic Physiology are offered in Chapter II.

Not omitting to thank the hundreds of strangers who, at divers times and places, have made kindly answer to my questions in the canvasses outlined, it is with especial gratitude that I can refer to the official and other sources of information which have made the statistical features of this work possible.

And last, but by no means least, let me warmly thank those whose financial assistance, in one form or another, proved the hinge upon which the work revolved to a public issue, and without which these findings could not have reached the printed page.

R. Clay Jackson.

Tacoma, Washington
November, 1926.

ORIGINAL SOURCES

The State Registrars of Vital Statistics of New Hampshire, Vermont, Maine, Massachusetts, Pennsylvania, West Virginia, Michigan, Indiana, Minnesota, Missouri, California, and the City Registrar of Vital Statistics of Tacoma, Washington.

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My departed friend, Dr. Alice Hurst of Detroit, Michigan, whose interest in my work was unfeigned and who, until the last, omitted no opportunity to promote the progress of my efforts.

My brother, Lt. Robert F. Jackson of Prospect Park, Pennsylvania, member of the Philadelphia Bar, for editorial and transcription work.

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CHAPTER I.

The Source of Some Grave Difficulties; A Hazy Horizon

1. The past few decades have seen a prodigious amount of research on the part of a multitude of able scientists and students of zoology into the age-old and ever-alluring problem of sex determination; and every current year sees large sums of money, available for educational and research work, set aside and used toward the solution of this elusive mystery. One who might possess a real and lively interest in the question, and yet who has never found nor taken the time to review its bibliography, would be amazed beyond expression could he but view, in one panoramic expanse, all the literature produced upon this subject during the last fifty years, but which has been virtually barren of definite results so far as the human species is concerned.

2. In fact, so void of results has been the entirety of this work that John Beard of the University of Jena declared in 1902 that "Any interference with or alteration of the determination of sex is absolutely beyond human power. To hope ever to influence or modify its manifestation would be not less futile and vain than to imagine it possible for man to breathe the breath of life into inanimate matter." Professor Thomas Hunt Morgan of Columbia University declared also that "The determination of sex is impossible; it is predetermined in the structure of the germ cell." And Leonard Doncaster, M. A., Fellow of Kings College, Cambridge, in the report of the Smithsonian Institution for 1910, committed himself to the same effect, but more tactfully, saying, "The overwhelming probabilities are in favor of the idea that the determination of sex is not consequent upon the accidental preponderance of one or the other of two nicely balanced tendencies, but rather that it is due to fixed and unalterable characters, inherent in the germ cell."

3. However, we hasten to congratulate Doncaster for having given us, in his comprehensive and worthy volume of 1914, a peep at a most lively family skeleton. His discussion opens with the question of the definition of the term "determination of sex." "____ it may be well to explain more definitely what is meant by the "determination of sex." Popularly it is often supposed to mean the production of one or the other sex at will, but this is not the sense in which the phrase is used in biology. The study of the determination of sex is the study of the causes which lead to the production of an individual of one or the other sex, and those causes, when discovered, may or may not be amenable to human control." Here it is seen that Doncaster has shrewdly pointed out that the question of determining what the sex of the coming individual will be is a vastly different thing from consciously controlling or dictating the sex characteristic of that individual.

4. I had read but little of the literature upon the subject before I became painfully aware of the fact that several authorities were at issue simply upon the score of confusing or ambiguous terms. Doncaster says that "to determine" does not mean "to control" and I heartily agree with him; but the standard dictionaries do credit "to determine" with meaning "to direct" or "to control." We are therefore compelled to reject any shading of meaning which creates trouble. "To determine" must be restricted to mean "to ascertain or to discover." Nor are there lacking in this outstanding volume of literature, occasions where terms of wholly different meaning have been employed synonymously. As for the word "metabolism" its definition is too weak and too dim to permit the use of the term with any great degree of satisfaction. It refers merely to a "change in the intimate condition of cells." Thus does it fail to indicate any possible character of such a change; it is not clear as to whether inter or intracellular conditions are referred to.

5. Building up and breaking down processes constitute the life cycle of cells and it is this class of phenomena, the designation of which is intended by the

use of the word "metabolism." When, therefore, Benedict, Emmes, Dr. Oscar Riddle, of the Carnegie Institution, and others inform us that metabolism is higher in the male than in the female parent they do not convey a very definite idea. It is possible that they mean that the *speed* of these cellular changes is greater in the male than in the female. But we are left to conjecture, for the definition of metabolism, as we have it today, does not convey, primarily, any concept of *speed,* or rate of motion whatever.

6. The school of "metabolism" (in sex determination) is working with the general viewpoint that whatever the sex character is, or wherever it is located in the germ cell, it fluctuates from time to time in its comparative power to express itself in the reproductive process, whether we comprehend the primary cause of those fluctuations or not. In order to make myself clearly understood when referring to this variable capacity in the germ cell, I shall hereafter use the term "sex potential" althought I cannot entirely escape the use of the term "metabolism" or of its derivatives.

7. Turning at will, and reading the story of the onward march of human progress and knowledge, we shall indeed seek in vain for any other part of it which presents such a hopeless floundering mass of uncertainty, contradiction, and general chaos as does the account of the work done thus far upon the subject here considered. From tadpoles to sheep, and from plant lice to guinea pigs,—all up and down the animal creation,—enormous volumes of patient work have been carefully performed. A few authentic facts have been set up but they have not all been interpreted fully, nor adequately correlated either to the question of determination or of control. A few experimental results obtained and reported by some have been repeated by others, but most such results have not been attained by others.

8. No more brilliant nor more exasperating example could possibly come to light than an article (1) by Pro-

Note (1) Science, N. S. vol. 25 (Jan. June, 1907.)

fessor Morgan in which he points to the work of Landois, Gentry and Mrs. Treat who claimed that in a certain species of butterfly the issue of sex in offspring could be regulated by a certain mode of nutrition, and, on the other hand, to the positive showing by Riley, Bessels, Briggs, Andrews, Fletcher and Kellogg that no such results could be produced in that species by any mode, quality or degree whatever of feeding or of starvation. And in the same article Morgan cites Cuenot's experiments with rats and those of Schultze with mice as showing no variations of sex in offspring under extremes either of feeding or of starvation.

9. The author of the article "Embryology" in the Encyclopaedia Britannica (1) engages in a blanket discussion on the question of the determination of sex. He specifies no particular species and therefore takes no cognizance of the suggestion made by Morgan (and concurred in by Professor J. A. Thompson) that "sex may be determined (2) by different methods in different cases." The article is largely interrogatory and not devoid of dogmatics. "Is sex determined at the act of conjugation of the two gametes? In other words, is it an unalterable property of the zygote, a genetic character, or does it depend upon the conditions to which the zygote is subject in its development? In other words, is it an acquired character? It is impossible in the present state of knowledge to answer these questions satisfactorily but the balance of evidence appears to favor the view that sex is an unalterable inborn character, and all attempts to determine (control) the sex of offspring in the higher animals have failed."

10. The New International Encyclopaedia (3) similarly fails to consider Morgan's suggestion. Under the caption "Sex" it says, "What, in the higher animals, determines sex, is an unsolved problem. Food or nutrition is as important a factor as any." And this article flatly contradicts the Encyclopaedia Britannica by proceeding,

Note (1) Eleventh edition.
Note (2) "Determined," meaning here "controlled." In speaking here of "different cases," Prof. Morgan probably means different "species."
Note (3) 1916 edition.

"Giron produced notable results in the feeding of sheep. He succeeded unquestionably in showing that good feeding for the ewes brought a sharp rise in the percentage of female lambs born. Dusing also succeeded in showing the same thing in the case of sheep;_____(His experiments) leave little doubt that abundant moisture and food produce females, while high temperature produces males."

11. Of the work of others the New International Encyclopaedia says, "Yung, working with three groups of tadpoles, raised the percentage of females in the first group from 54% to 78% by feeding beef. In the second group he raised the percentage of females from 61% to 81% by a diet of whitefish, while in the third group, on the highly nutritious diet of frogs' flesh, the percentage of females rose from 56% to 92%. That is to say that, by a diet of frogs' flesh, he lacked only 8% of turning all the tadpoles into females. Siebold's observations on wasps tended to show that a predominance of females is due to better nutrition."

12. It must be pointed out here, however, that in the case of the tadpole, there is a vastly different state of affairs from that in the case of a human embryo. It has been pretty generally agreed upon by numerous scholars that in the human species, as well as probably in all the higher mammals, the sex of the new individual is fixed at the moment of gametic union, and thereafter cannot be changed, while in the tadpole we have an embryo already far on the road to becoming an adult at the time it yields to Yung's famous experiment. (Before the close of this work the reader will be afforded proof that the above conjecture for the human species is absolutely correct).

13. Says the Encyclopaedia Britannica further under the caption "Sex": "Popular belief, and some observations with regard to the breeding of domestic animals, have led to the inference that the sex of the offspring tends to be that of the less vigorous parent,—and such a theory has gained more attention than the facts sup-

porting it would justify. (On the other hand) several unbiased observers have interpreted the events in the sense that the (more) vigorous parent produces his or her own sex." Also, "It has been noted that when aphides (Plant lice) are under the favorable conditions of summer temperature and nutrition they produce only females, but that the advent of autumn brings with it an equality in sex production."

14. We thus note at once a dispute among observers as to whether the stronger or weaker parent tends, preferentially, to transmit his or her own sex. This question may indeed be debatable for some of the higher animals (though certainly the case for sheep has been settled by both Dusing and Giron), but in the human species it takes on a most remarkable and definite aspect. Dr. Romme, of London, quite a number of years ago, from a long period of experience, made the observation that mothers of the human species who went into a decline of health, in the majority of cases began to produce daughters only, if child-bearing continued at all.

15. My own work had been under way more than two years before finding this reference to Dr. Romme's conclusions, and during that time I had also been making discoveries steadily to the same effect. And this does not conflict, as I shall show later, with the other fact, equally obvious, that we frequently find mothers in prime health and of great vigor also producing daughters only.

16. As for the matter of reference to plant lice and their seasonal variation, we may note but briefly here, that fleeting glimpses of seasonal variations in numerous lower species have been pointed to by different observers from time to time. This is a remarkable characteristic of the genus homo in many localities, and no investigator hitherto appears to have given it any consideration at all. Dr. Oscar Riddle and his worthy predecessor, Prof. Whitman, outlined regular and sharply defined seasonal variations in the pigeon's hatch. Dr. V. R. Cline, (veterinary) of Seattle, Wn., states recently

that the female fox is definitely predisposed towards producing female puppies by a period of illness or distemper, and also that the chinchilla rabbit shows a heavy urge toward male sex production in the Puget Sound region in winter;—the rainy season.

17. Physicians have frequently set up and defended the hypothesis that ova from one ovary develop into females only, whilst those from the other ovary develop into males only. This view has been thoroughly discredited; nevertheless we find renewed adherence to it constantly arising. For convenience we may term it the "bilateral theory of sex". This theory has been more recently revived and published in book form by the late Dr. E. Rumley Dawson (England), who claims justification for it in certain phenomena which he has met in clinical work. He succeeded in assembling a large amount of important and interesting data, but his main argument, and conclusion, it seems, can hardly be maintained against the mathematical aspects of the case.

18. Let us elucidate: A normal female (genus homo) is possessed of two ovaries. Thirteen times a year, an ovum is discharged from one or the other ovary, and thus, in the course of her thirty years of sex-life (say, from 16 to 46), a total of 390 ova (barring periodical pregnancies) pass from the ovaries. Let us assume that 6 pregnancies occur and mature in this model case. This means the interruption of the passage of about 58 ova, all told. Therefore, her actual discharge of ova will be approximately 332, which are derived about equally from each ovary. During the thirty years, we may estimate that 3,120 copulations occur. Therefore, Doctor Dawson would have us believe, in the case of a mother who has produced 6 daughters only, that out of 166 ova discharging from the right ovary and out of 3,120 copulations (more or less—and all performed at random and under blind physical impulse) there never was once an opportunity for a single ovum from the right ovary to become fertilized and thus to result in a male. Merely

Note: So keen has been the interest in the problem that Dr. Dawson's work has reached its third edition.

to state this mathematical disproportion of probabilities, which his hypothesis sets up, is enough to dismiss the latter as wholly untenable.

19. In answer to Dr. Dawson's argument, it is amply evidenced by competent observers that the removal of one ovary has not noticeably resulted in the suppression of the issue of either sex in particular. However, in rebuttal, we further find Dawson claiming that in no case of ovariectomy is it absolutely certain that all of the gametogenetic tissue has been removed.

20. But his theory continues dubious when we contemplate a multitude of cases of mothers of great vigor and perfect health whose only indisposition through an active lifetime was upon the occasion of confinement, and, yet, among whom we have those persistently giving birth, in some cases, to boys only, and, in others to none but girls. It would appear thus that Dr. Dawson has strongly presumed upon the phenomenon of bisexuality of the species, as a whole, to explain away the bilateral development of the sex-organs.

21. There is a fact, adequately attested, as Professor Thomas Hunt Morgan tells us in "Heredity and Sex", which might possibly be cited to some advantage in the further dissection of Dr. Dawson's theory; namely: that, if by any means, the female frog be compelled to retain her eggs in the uterus for two or three days beyond the normal time for their deposition, the issue will be 100 percent males.

22. Since also in the frog the ova issue in approximately equal numbers from each ovary, and since also, under normal conditions, sex in frogs issues about equally distributed, then the fact cited by Professor Morgan, in the light of Dr. Dawson's theory, will force us to conclude that the female frog overheard in advance the contemplated experiment upon her person and that, for some unknown reason, she deliberately suspended the functioning of her left ovary.

23. Since Dr. Dawson's proposition is only theory, and Professor Morgan's citation is fact, the absurdity of such a conclusion causes a complete crumbling of the theory—favoring the fact.

24. Thus we know from experience, in the case of the frog, that, in all normal and nonmanipulated cases, the eggs do descend from the ovaries, capable of becoming both male and female, and we, therefore, are compelled to admit that, in the case cited by Professor Morgan, the ova descended from both ovaries with male and female potentialty about equal. The conclusion is inescapable that in the case of the frog, sex-distinction did not arise in the ovaries, but, was gradually thrust upon the ova as a result of, or concurrent with the change of environment from ovary to uterus.

25. In all of which I do not wish to minimize Dr. Dawson's emphasis on the probability that no one species could safely be pointed to as a criterion by which the complete mode of sex differentiation may be ascertained for any other species. Nevertheless it is impossible to concede that the bilateral ovarian structure of the female frog could be interpreted in any way different from that of the human female.

26. It is my purpose in this work to present that which the facts seem amply to warrant, viz.
That the operation of the prime factor in the determination of sex, depends basically upon environment; that the Human mother is not, by any stretch of the imagination, a monopolist of sex-determining power, but that each sex is in possession of a separate factor of mono-sexuality—the mother conferring femaleness, or the father conferring maleness as the case may be,

27. Furthermore, I cannot omit here to point out the sudden development of 400% excess of female births in Sunapee Tp., Sullivan County, N. H., in 1917 and to ask, in the light of Dr. Dawson's theory, if the reader can believe that during 1916, in that territory, the right ovary of four mothers out of five suddenly became in-

active? Such a phenomenon solely on the basis of a coincidence is absolutely out of all reason; and the pressure of Dr. Dawson's views would make it necessary to explain what definite influence common to these 400% of excess female cases could possibly act as a deterrent against the regular functioning of one ovary.

28. Nor is the foregoing, by any means, all of the argument to be marshalled against the bilateral theory. If bilateralism in ovarian structure is the basis of sex differentiation, then the Dawsonian hypothesis must of necessity include the meaning of bilateral development in the sex economy of the father as well. Both the right and left ovaries of the Human female are normally active, but in birds the left ovary only is active. What about this?

29. To claim that bisexuality results from a bilateral sex structure is no more logical than it would be to assert that the inhalation of oxygen and the exhalation of carbon dioxide results from bilateral nasal or pulmonary structures.

30. To further complicate the situation, both the Wilson and the McClung hypotheses of sex maintain that in birds the female only supplies the gametes of both sexes, while in the higher mammals the male only similarly functions. However, in a letter to me from Professor McClung under dating of July 20, 1920, he seemed somewhat to qualify his position, as I quote him:

31. "You will see from the nature of my determination in the organization of germ cells that it would be quite impossible for me to agree with you that external agencies should have any influence in modifying the nature of sex. However, there are various conditions in different groups of animals, and no one specific assertion could be made from any one of them." (1)

Note (1) Professor McClung probably intended to say, in part, "However, there are various conditions in different groups of animals and no assertion, susceptible of general application, could be made from the conditions in any one group."

32. Thus he admits that it would not be safe to measure the case for the human species by standards obtained from any lower orders, and I fail utterly, therefore, to attach any considerable degree of importance to his hypothesis of 1902.

33. The wail which is quite general, that there is a great dearth of human material with which to work out the problem, lacks even the status of a respectable alibi. I am satisfied that in many localities on the earth the human species is to be found as plentiful as is almost any other sort.

34. Nor is this chaotic state of affairs due solely to the natural elusiveness of certain phenomena or of experimental results, for, in digesting this mass of literature there are to be found instances in which one authority has actually failed to report correctly the findings as announced by another. For example Punnett made certain researches among three strata of London society as to the effects of nutrition upon the numerical proportions (sex ratio) of children born. Professor F. H. Pike claims (1) that Punnett found no appreciable differences in the cases examined, while on the other hand both Professor Morgan, in his volume "Heredity and Sex", and Doncaster claim that Punnett reported more females born to the poor than to the wealthy. It is therefore plain that some of these have erred in their citations.

35. A very serious objection also arises as to the value of the method employed by Punnett, since it appears that he was not looking for differences between the nutrition of fathers and mothers in his cases. The question of whether an entire class in society habitually over eats or is constantly half starved, cannot possibly have any bearing on the case. If Punnett had sought for husbands who slaved and starved whilst their mates constantly ate to excess he might have obtained some data on nutrition for the human species which would have repaid him for his pains.

Note (1) American Naturalist, May, 1907, p. 306.

36. There is a lively cycle of speculation revolving about the question as to whether sex depends upon the female gamete (ovum) or the male gamete (spermatozoon) being more nearly fresh at the moment of their union,—and further as to what conditions preserve freshness or induce staleness in the gametes. I concede the importance of the question but it is not basic to our problem; nevertheless I shall yet deal in greater detail with it. In some individual cases it is closely synchronized with the menstrual phenomenon, but there is overwhelming evidence in statistics that a more potent influence than that involved in menstruation *(per se)*, operates to render the germ stale.

37. In the course of a conversation with me in 1919 Dr. Robinson of Highland Park, Michigan, stated it to be his firm conviction that fresh spermatozoa lately produced, were much more likely to induce the production of male offspring than were other spermatozoa which had long suffered testicular retention. He pointed out, upon this concept, an obvious mode of procedure for the control of sex in offspring and was positive in his claim to knowledge of cases in which control and reversal (from females to males) had been effected. However, in the case of spermatozoa just as in the case of ova, statistics will easily place his method of control as only marginal or opportune, and not basic.

38. It seems that several competent observers of live stock are agreed that when a sire who has had a period of complete rest is admitted to a flock or herd the earlier births show a female preponderance, while later births move definitely towards male preponderance. This phenomenon is corroborative of Dr. Robinson's statement on the case for homo, and establishes clearly the fact that general physical exhaustion is not at all proportioned to gametic exhaustion or staleness, but rather the reverse, that, as related to the general reproductive process, physical exhaustion is accompanied by a rise in the sex potential or gametic strength.

39. I quoted Professor McClung as repudiating the

idea that any condition or influence external to the germ cell could modify the manifestation of the sex characteristic, but set over against Professor McClung's opinion on this point is the discussion of Leonard Doncaster who says, (1) "however there is a considerable mass of statistics, in the case of man and the higher vertebrates, which still upholds the theory that various external circumstances may affect sex proportions in births." He states that in the case of the bee it has been overwhelmingly proved that sex is irrevocably established from the beginning of the egg development. He seems to regard the Wilsonian hypothesis (2) as a step in the direction of the truth, but he does complain that such phenomena as those upon which it is based, have not been observed to any sufficient extent outside arachnids and certain insects.

40. In the Proceedings of the Royal Society of London there is presented an able paper (3) by Punnett who records his experiments with the rotifer, hydatina senta. Here Punnett quotes Nussbaum as having rejected temperature as being any factor in the problem. Punnett recites carefully, detail after detail of his own experiments, from which all errors were removed, and he shows that at least with the said species, neither extremes of nutrition nor of temperature produced any effects related to the issue of sex in offspring. (4)

41. Reference has already been made to the work of the late Professor Whitman and of his able successor, Dr. Riddle of the Carnegie Institution at Cold Springs Harbor, N. Y. It is exceedingly doubtful if any other

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Note (1) Vide annual report of The Smithsonian Institution for 1910.

Note (2) In 1909 Professor E. B. Wilson offered a most commendable summary of all the reliable evidences and observations which until that time had been developed by prominent scholars, relating to intra-cellular (or cytological) processes. In more than one hundred species of spiders and insects it was shown that there were two kinds of spermatozoa produced in equal quantities. Of these two kinds, one contained a certain characteristic not found in the other. The ova of the females were found to be void of any sex characteristic (asexual). Consequently if an asexual egg became fertilized by a spermatozoon containing the "X" element it developed into a female. If fertilized by a spermatozoon lacking the "X" element a male resulted. This, in essence, is the Wilsonian hypothesis, which, without warrant of fact, has been assumed to cover the case even for the human species.

Note (3) Series "B", December, 1906.

Note (4) Note here the contrast to the case of sheep (Par. 10), in which, as quoted, the Encyclopædia Britannica claims temperature as a positive factor.

two co-workers upon the problem have ever accomplished half as much as have these persistent, patient, and accurate investigators. It is impossible here to do justice to Dr. Riddle's exposition of their joint achievement as set forth by him in two papers (1). The reader is urged to the consideration of these two publications. These authorities have accomplished sex control and reversal for the offspring of pigeons, and have repeatedly duplicated the test.

42. They have shown the chemical phenomena in the egg correlated to the production of one or the other sex. Their work deals extensively with conditions accessory to the freshness or staleness of the gamete, and the findings of still other authorities are cited as support.

43. We have long listened to the futile elucidations of the "fatalists" and "pre-determinists" upon the cytology of the germ cell, its chromosomal arrangement and structure. They have constantly explained the machinery and its various parts but they have failed to apprise us of the nature of its motive power. Dr. Riddle stills the whole tumult when he calls them to acknowledge the fact that "the chromosomal constitution of the germ cell is not an efficient (basic) cause of sex." Their last stronghold has been taken and the day belongs to the school of metabolists.

44. He has disclosed a wider range of potent research into the physiological and bio-chemical characteristics of the case than has emanated from any other source, and, notwithstanding his failure to point out a definite prime motive power (which his discussion plainly implies must exist), he has correctly shown the significance and relativity of a larger volume of marginal or tributary phenomena, than has any other student of the subject thus far.

45. No eulogy of mine can here do justice to Geddes and Thompson whose courageous assertions in favor of

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Note (1) Vide Science, N. S. vol. XXV, March 22, 1912, and vol. XLVI, July 6, 1917.

the metabolic basis proved them, long ago, shining heralds of the truth.

46. Up to this point we have taken but a glimpse at the heated controversy which has raged until the present, and it has revolved almost entirely about the lower orders of animals. A few scattered observations have hitherto been offered as to the case for man, but as a whole, we launch into unknown waters in attacking the problem for this chief primate. When I commenced work upon the subject it was new to me, and this probably accounts for my failure, at that time, to look into the matter of prior investigations. As it is, my studies had gone on nearly three years before I undertook the review of which this chapter is only a sketch.

Note: I have not touched here the endless and heated arguments over statistics, having reserved that as a more integral portion of what follows.

CHAPTER II.

A Review Of Genetic Physiology

47. A work of this character would logically invite some consideration of the physiology of the germinal process and it will be to some advantage to look into the findings of science upon the subject.

48. When the human female is born her two ovaries are already the repositories of several thousand ova. These remain in situ until she reaches the age of puberty (about fourteen years in normal cases) at which the active development of the sex nature begins. From this time forward, during a period of some thirty years, the ova are discharged, ordinarily one at a time every four weeks, issuing, it is believed, alternately and about equally from each ovary. Thus, in thirty years, some four hundred ova are discharged;—this activity being ordinarily held in abeyance by pregnancy and lactation.

49. When the ovum or egg is sufficiently developed it passes from the ovary into the Fallopian tube, a duct leading to the uterus. The ovum has no power of locomotion of its own, but it is propelled forward by a sort of wave like motion of the lining of the Fallopian tube. The spermatozoa (the gametes or germs) from the father, introduced at the time of copulation, pass into the uterus, many millions at a time. These are very small indeed, much smaller than the ova, and can be seen only by use of the higher powers of the microscope. Each is shaped somewhat like a young tadpole with a disproportionately long tail by which it propels itself forward in a manner similar to the motion of a tadpole. They ordinarily meet the ovum in the upper Fallopian tube before it has travelled far from the ovary.

50. Here the union of a spermatozoon (1) with an ovum takes place through, (as some contend), a sort of

Note (1) Not all authorities are agreed as to the number of spermatozoa which unite with a single ovum; most have inclined to the opinion that only one spermatozoon enters.

"selection" exercised by the ovum. The head of the spermatozoon penetrates the wall of the ovum; it sheds its tail and the head passes on into the protoplasm of the ovum. The ovum, thereby, becomes fertilized, (given the power or impulse to grow). The fertilized ovum, descending the tube, at once begins the process of growth by fission; that is, the original fertilized cell divides itself into two new cells, these two, in turn, dividing into four new cells, and so on. After the first division it is no longer an ovum or gamete; it is termed a "zygote." The zygote constitutes quite a group of primary cells by the time it reaches the uterus which it finds lined with a special soft tissue filled with blood. This membrane or lining is called the "decidua." The small group of cells sinks into the decidua which closes over them. They attach themselves, under cover of the decidua, to the back wall of the uterus. It is through this attachment that circulation, nutrition and general development for the foetus come during a period of about two hundred and seventy days,—or until birth.

51. The human ovum (unfertilized) is about one one-hundred-and twentieth of an inch in diameter. This would occasion some wonder, no doubt, when contrasted to the egg of a chicken which is about an inch and a quarter in diameter and an inch and a half or more in length. But a vast difference otherwise must be considered. In the human species the mother constantly supplies the zygote and the developing foetus with all essential nutrition, whilst in the chicken, the egg carries not only a vital expression, which is only a tiny nucleus, but also enough food in storage for the developing chick to last it for the period of incubation, or about twenty-one days. This, then, constitutes the reason for the great disproportion in the sizes of the two ova.

52. It might be well here also to refer to the mode of development of twins and triplets. These cases are not yet altogether clear and are, in part, the subject of much controversy. We have stated for a model case that only one ovum is discharged at a time. This may not al-

ways be true. There is no reason to contend that it is. It is more than possible that two or three or even more ova may be discharged by the ovary of the human female, and that they may be fertilized simultaneously and similarly develop. Again, two or more ova may be discharged at intervals of a few hours and may be separately fertilized by successive copulations.

53. There are also cases in which we find the occurrence of what are termed "identical twins." These are always of the same sex and their appearances are so nearly alike as to render confusion in the identity of each a very easy matter. Most, if not all authorities, have advanced the idea that these result from a split zygote, that is, a developing and fertilized ovum which has become divided into two parts, mechanically separated from each other. There have been numerous similar occurrences noted among lower species which would uphold this theory. On the other hand, I see no reason why two separate ova, developed mutually adjacent, in the same part of the ovary, should not both be discharged and fertilized at the same time, be nourished exactly alike and in this way also develop identical twins. This conjecture, however, would involve an almost improbable amount of coincidence, though it is not outside the realm of possibility.

54. One of the most animated phases of the discussion has been upon the mode of origin of both sexes at one birth, bisexual twins or triplets. This, for a long time, was a leading stronghold for the "predeterminists", but in reality it amounted to nothing more than a smoke screen. It does not present any insuperable difficulty to the school of metabolists. Having admitted as plausible the concept of a varying and variable sex potential for different ova and for different spermatozoa discharged at the same time, or of sex potential differences incidental to discharges of ova and of spermatozoa at different times, a result in terms of bisexuality in multiple births, is not a matter of any unusual distraction, whatever.

55. The physiology of sex for the human male is, if anything, simpler than than of the female. The spermatozoa are generated by the testicles, in which they are retained until expelled, usually voluntarily in copulation, or, occasionally involuntarily, under some unusual or perhaps irrelevant mental stress.

56. No reference has been made here to the internal structure or characteristics of male and female gametes, nor to the reactions in the fertilized ovum preparatory to the first cell division. My concept of the case is that the sex producing operations within the gamete are only the result of an external motive force and having now in hand a working estimate of this primary motive force, it has not been necessary to consider the cytological phase of the matter at all. Cytology can avail us nothing here for before we can inspect its operations we, perforce, must subject the germ cell to an exceedingly abnormal condition and environment, which cannot but preclude our arrival at any estimate of what its normal reactions may be.

CHAPTER III

A Clue And The Convergence Of Several Facts

57. In 1916, while in Philadelphia, I found in a News column devoted to scientific facts, the following item:

"According to a German official medical authority fifteen minutes exposure to the sun's rays during an airship flight at high altitudes will kill all the tuberculosis germs in a man's system."

It impressed me strongly to learn that sunlight could have such a powerful effect upon disease germs within the human system. This item reminded me at once of two other facts. (1)

58. Some years before, in discussing with a Radiographic expert the effects of radiation from the Crooke's tube, I learned that in the shops in which high frequency electrical apparatus is built and continually being tested, the operators are obliged to wear lead aprons to protect their sex economy from being totally sterilized by the X ray. This was fact "Number one." Another scientific note which had come to my notice some time later was to the effect that germ life cannot exist longer than fifteen or twenty minutes when exposed to sunlight on a dry pavement. This was fact "Number two".

59. To my mind these considerations seemed quite potent: the question immediately arising, "If sunlight has such a powerful effect on a disease germ, what is its effect upon the reproductive germ, hidden away in the recesses of its generative environment?" I was forced to doubt that the reproductive germ was free from a profound influence exercised by the forces of radiant energy which pour out upon us from the center of our

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Note (1) A famous American aviation ace claimed that he was saved from incipient tuberculosis by his service in the air, and during 1918 medical authorities of the British Army corroborated the German observation as quoted above.

solar system. And at the threshold of these suggestions trembled the logical suspicion that in close proximity might be found the answer to the age old problem of the determination of sex.

60. The idea suggested itself that if either the male or the female germ came excessively under the influence of sunlight the result would be to lessen the potency of that germ. And if, simultaneously, one sex germ suffered an excess exposure to sunlight and the other sex germ enjoyed the benefit of a measure of protection from sunlight, the resultant sex of the child to be would favor the sex of the parent who had had the benefit of the most protection.

61. My first impulse, very naturally, was to begin experiments with some small animals, (rats or guinea pigs) ; but such work being inexpedient for me at the time, it appeared to me as logical that if exposure to or protection from sunlight was the condition for reducing or increasing the strength of the sex character in the germ cell, then the line of variation in the sex of offspring in the human species should roughly parallel the occupations and general life habits, (indoors and out), of the prospective parents. Thus a strict and unmodified application of the dimly formulated theory would assign to a male bookkeeper, whose life is spent within brick, stone, steel, or concrete walls, a progeny of sons only, while the families of such as railroaders, street sweepers, roofers, teamsters, and so on, would be composed of daughters only, or at least of an overwhelming majority of daughters.

62. It will be noticed that thus early I had no idea whatever, other than that the father and mother, each individually, was possessor of a germ of his or her own sex alone. I was not hampered at this time by the Wilson or McClung hypotheses of sex; nor have I been at any time since to any disconcerting degree.

63. Accordingly I at once began a canvass of teamsters and chauffeurs. My first interview was with three

drivers engaged in teaming. I asked one of them a few preliminary questions and then sought information as to whether he had a family and whether they were boys or girls. He replied, "Yes, three girls." My astonishment can better be imagined by the reader than I can describe. I asked the next one about his children. He had two girls and one boy, and the third man had only one child, a girl. Also the form of my questions had brought answers which showed that this total of children had been born while the fathers were engaged in this outdoor occupation of teamster. I asked the two who had no sons if they did not think it about time to quit teaming and see if their luck with babies would not change. They looked mystified and probably wondered more than once what I thought teaming had to do with babies. The data I had gathered thus showed that the chances on the first three cases were six to one in favor of the "idea." The idea then rose promptly to the status of a respectable hypothesis with some very good reasons to substantiate it.

64. For some days I continued to take data in the case of teamsters and chauffeurs. Fifty-six cases may seem to be only a few compared to the scurrying army who daily drive Philadelphia's vehicles through her streets, but not every driver whom I saw afforded either excuse or fair opportunity for a conversation. Totalling the results in this number of cases, however, there were 203 children and the division showed 117 girls as against 86 boys. This was about 36% more girls than boys. Looking up the question as to the normal ratio of boys to girls in births for the whole population, I found that for the entire United States, out of 2053 births, 1000 are girls and 1053 are boys; 5.3% excess of boys. Therefore in my group of the families of teamsters and chauffeurs there was an actual excess of girls above normal of about 40%.

Note: In any case by dividing the total number of males born by the total number of females born we obtain a decimal. For example:
1053/1000=1.053. This result is termed the "male sex ratio."
To obtain the female sex ratio we reverse the division:
1000/1053=.947, female sex ratio.
In the teamster group cited we have:
86 (males)/117 (females)=.735, male sex ratio.

65. I was much encouraged by this first canvass. It occurred to me, too, that the United States census records might yield information of value on the subject, but upon looking these up was disappointed. The only census records of any value to this work would be the original house to house sheets on file in Washington and at that time I had no opportunity to see these. Reflection upon the alternative of making a residence canvass for more facts seemed to stamp in advance such a course as hopeless because of the formalities involved and the delicacy of the subject.

66. I decided to obtain the birth returns for some locality, month by month, and the record of the Weather Bureau on cloudiness for the same locality, and for approximately the same time and compare them. If my hypothesis was correct, then it might be that the peaks in the curve constructed from cloudiness statistics would be followed after a space of time of something more than nine months (the period of human gestation) by corresponding peaks of male births in the sex ratio curve.

67. Upon application to the Weather Bureau at Philadelphia for an inspection of the cloudiness records on file, I observed that the year 1876 was the cloudiest year along the North Atlantic coast in the history of the United States Weather Bureau, and that in June of that year the condition of cloudiness rose to its highest point. It therefore became desirable to include the year 1876 in the construction of the curve. This fact will serve as an answer to the inevitable question of why I turned to the records of some fifty years ago. At the bureau of vital statistics for Philadelphia I found that the records for birth returns did not extend back as far as 1876, but I was informed that Boston did have complete returns on births beginning in 1871.

68. I obtained birth statistics for Boston for the years 1872 to 1878 inclusive and from 1911 to 1914, a total of eleven years of figures, month by month. I had previously procured a chart for Boston showing its

cloudiness, month by month, from 1871 to 1877, inclusive, and from 1910 to 1913, inclusive. With these data in hand the curves shown in the first fourteen plates following were completed.

69. An inquiry into the relation between these cloudiness and birth curves will follow. Observe first that corresponding reactions in the two curves are denoted by similar lettering.

70. PLATE 1. At the beginning of the year 1871 (at "A" in January) cloudiness is high. A′ in the sex ratio curve on Jan. 1, 1872, shows a high proportion of male births which was still higher and probably at peak in December, 1871. Thus A′ is a reaction from A. For a period of thirty days the sex ratio curve is out of step with the cloudiness curve and it is so designated. A drop in cloudiness, (an increase in sunshiny days) at B in February, 1871, is answered by a heavy excess of female births thirteen months later at B′ in March, 1872. April, 1871, is cloudy (C) and twelve months later, in April, 1872, there is a return to an excess of male births at C′. Again at D in May, 1871, there is a lessening of cloudiness (more sunshine) and it is answered faithfully by another excess of female births at D′ in May, 1872. Another twelve-month reaction of "cloudiness and male births" occurs from E, July, 1871, to E′, July, 1872, and so on to the end of the year the synchronism between the two curves is practically complete, as shown, letter for letter, although the dip H′ in the sex ratio

Note: In the case of Boston as has been the usual custom of the Weather Bureau in the past, three items are rendered for each month: "No. of days clear," "No. of days partly cloudy," and "No. of days cloudy." I have always treated such data as follows: No. of cloudy days plus ½ the no. of partly cloudy days=the total no. of cloudy days in the month. Lately, however, the Bureau has begun a practice of entering a month or year as being cloudy by a certain percentage; e. g. the case of Eastport and Lubec, Maine, Plates 24 and 25 Q. V.

Note: The upper heavy curve is the cloudiness curve. The number of computed cloudy days being shown by numbers each month following the contour of the curve. The lower curve is the sex ratio curve, the scale along the lower line giving the decimal calculations. All portions of the curve above the base line show an excess volume of male births; all portions below show an excess volume of female births.

Note: The thin intermediate curve is the curve of rainfall, (including reduced snow), in inches per month as per the numbers following the curve contour. Late developments in the work due to pronounced and unexpected results for the city of Indianapolis, Ind., have made it desirable to include the rain curve as well, but little or no reference will be made to it until the close of the discussion on cloudiness.

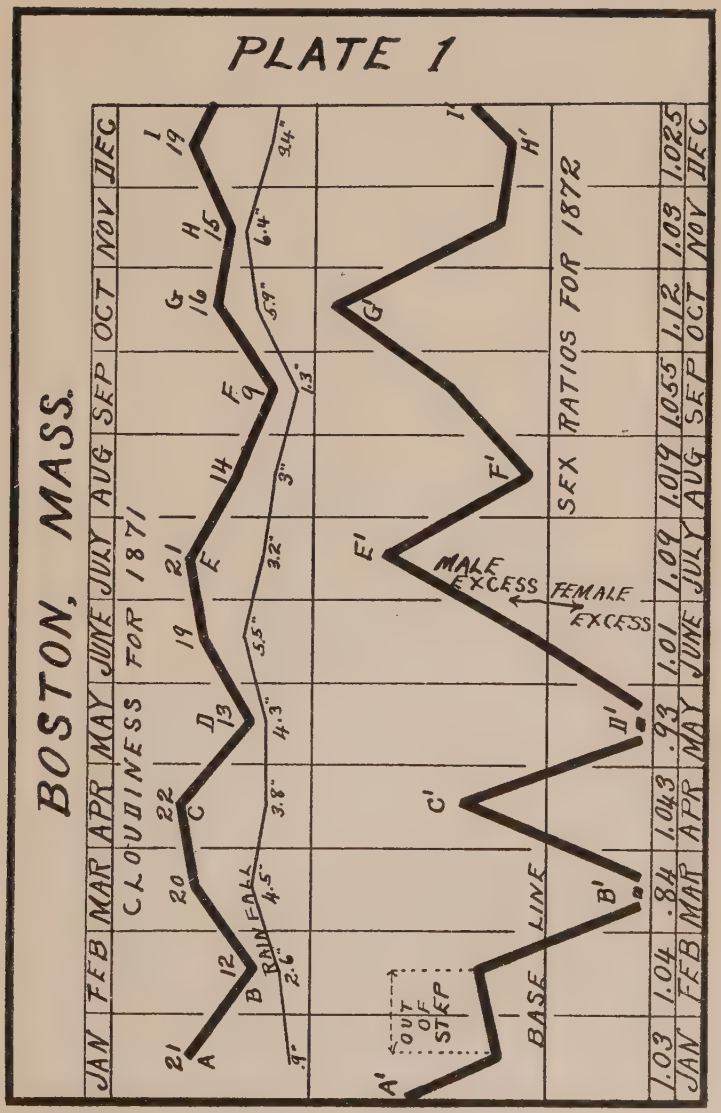
PLATE 1
BOSTON, MASS.
JAN FEB MAR APR MAY JUNE JULY AUG SEP OCT NOV DEC
CLOUDINESS FOR 1871
SEX RATIOS FOR 1872
RAINFALL
BASE LINE
OUT OF STEP
MALE EXCESS
FEMALE EXCESS
1.03 1.04 .84 1.043 .93 1.01 1.09 1.019 1.055 1.12 1.03 1.025

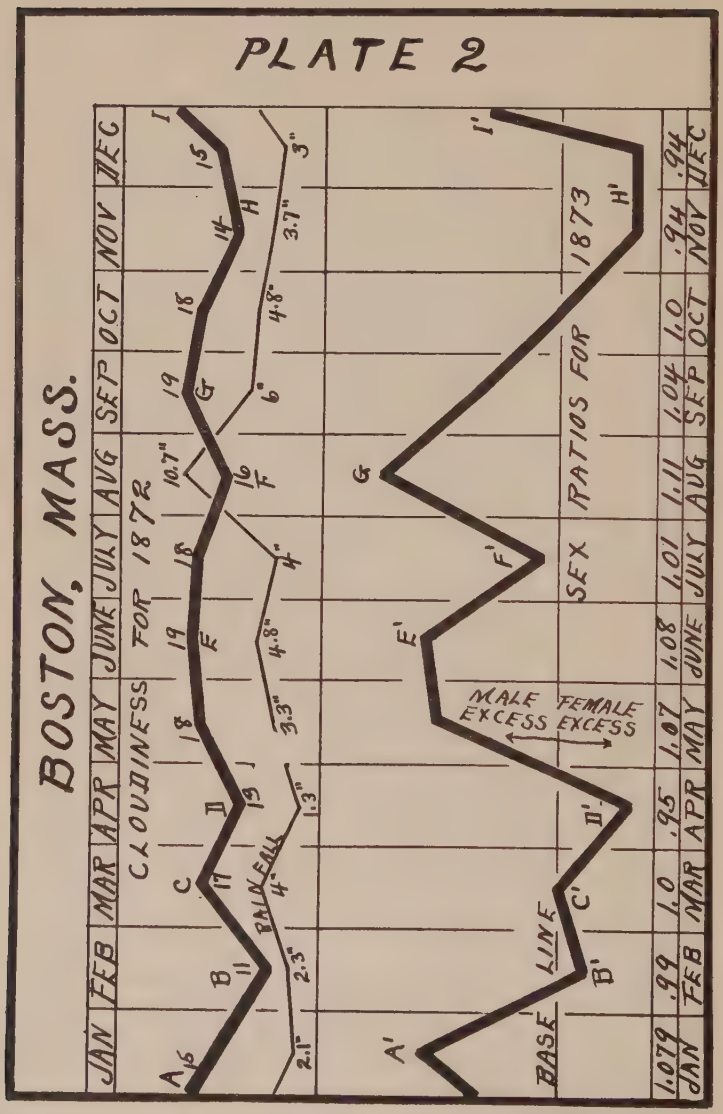
PLATE 2
BOSTON, MASS.
JAN FEB MAR APR MAY JUNE JULY AUG SEP OCT NOV DEC
CLOUDINESS FOR 1872
RAINFALL
BASE LINE
MALE EXCESS
FEMALE EXCESS
SEX RATIOS FOR 1873
1.079 .99 1.0 .95 1.07 1.08 1.01 1.11 1.04 1.0 .94 .94
JAN FEB MAR APR MAY JUNE JULY AUG SEP OCT NOV DEC

curve seems quite disproportionate to the slight dip H in the cloudiness curve.

71. For 1872 and 1873 (Plate 2) tracing similarly, the sequence in reactions is quite faithful and at the end of the year occurs a most marvelous parallel in shapes, G-H-I and G′-H′-I′.

72. By this time, no doubt, the question will have been asked as to why the reactions between cloudiness and births is twelve months long, whereas the period of gestation in the human species is but nine months long. This phase of the matter is discussed later, but I point out now that if the reader has been closely observing, some of these reactions are thirteen, some eleven and some ten months long. There are one or two instances in which the reaction is only nine months long, showing that in a number of individual cases the rising or falling sex potential reaches its preponderant differential value within the same month in which conception occurs. In one instance the reaction between the two curves is fourteen months long.

73. At this time, too, something more detailed will be expected as to the process of reasoning by which I have related an excess of cloudy days to an excess of male births, and an excess of sunny days to an excess of, or an increase in, the proportion of female births. The full answer to such a question would call for the impossible, namely, a disclosure in detail of the domestic and industrial habits of every parent in the city of Boston during the time to which these records relate. But for one's temporary satisfaction it may be pointed out that among almost all civilized peoples down to the present time, the majority of men have followed pursuits and pastimes which have called them out of doors intermittently or kept them out of doors in day time to a far greater extent than have women. The majority of women, occupying a sphere and following pursuits which have kept them largely indoors, have, just to that extent, been quite free from the variations in sunshine which affect men out of doors.

74. We are dealing here with cloudiness likened to a mighty valve by means of which sunlight is intermittently poured out upon the earth or largely shut off from it, and to determine the results of such a phenomenon which exhibits its major phases out of doors, we are rationally obliged to apply our questionnaire to that particular sex, the activities of which are mostly out of doors.

75. Exemplifying this principle theoretically, we might say that if a woman remained constantly within a house which excluded nearly all solar radiation, and if her mate worked only and constantly out of doors in daylight hours, and if all other modifying factors, known or conceivable, which enter into the problem, were absolutely equal for both, then all the children born to them would be females. Further, under such conditions it is easy to see that the man's sex potential would be affected in direct proportion to the variations of cloudiness, and that if, for him, there existed any chance at all for producing a son, it would be at some time shortly following a season of cloudiness.

76. The general habits of men and women, however, as referred to in the last few paragraphs, are subject to an important distinction based primarily upon the question as to whether it is the aggregate of urban or rural life in modern times which is considered; i. e., a housed, industrial, city population, or a population following strictly farming pursuits. In the case of the city the mass of mothers have a fixed indoor habit, while upon the fathers falls the variable habit, indoors and out. On the farms the mass of fathers possess the more nearly fixed habit, out of doors, while the mothers have the variable habit, indoors and out, and their outdoor habit, for the most of the year, is extensively regulated by the rainfall. The fact is yet to be faced, that the sex ratio curve in many units of territory is closely correlated to the curve of rainfall.

77. If men followed pursuits within doors, and women were occupied without, we should then look for

an unusual proportion of female births instead of male births to follow seasons of cloudiness, with this difference, however, that under such conditions we could scarcely hope to find an actual excess of female births at any time; the reason for this is that the weight of men is usually greater than that of women and weight is favorable to the sex potential as will be referred to in the next chapter in which I deal with it as a primary modification.

78. It is believed that the foregoing theoretical depiction of results of out door activities of potential mothers will be found to be supported by statistics for such countries as Bulgaria, Greece, Rumania and perhaps several Latin countries in which women do perform an excessive proportion of outdoor work, for in these countries the national male sex ratio in births frequently rises to an excess not reached by other Aryan nations.

79. PLATE 3 gives the cloudiness of 1873. Recall the fact that in that year there occurred the most disastrous financial cataclysm the United States had ever experienced. Business came to a standstill, industries closed; there were thousands of bankruptcies and many hundreds of thousands of workers were forced into idleness and their habits of life were suddenly changed to a great degree. It would be a difficult matter to attempt to trace much of detail in such a change, even were it of any advantage to do so; but, in spite of these economic and industrial disturbances, the reaction of cloudiness upon birth sex holds true through most of 1874, (the sex ratio curve being out of step only eighty days toward the end of the year), and also through other years at a time during which there was industrial unrest and financial depression.

80. Those who until the present time have so vigorously contended that birth statistics reveal nothing susceptible of interpretation, should consider the following yearly ratios for Boston:

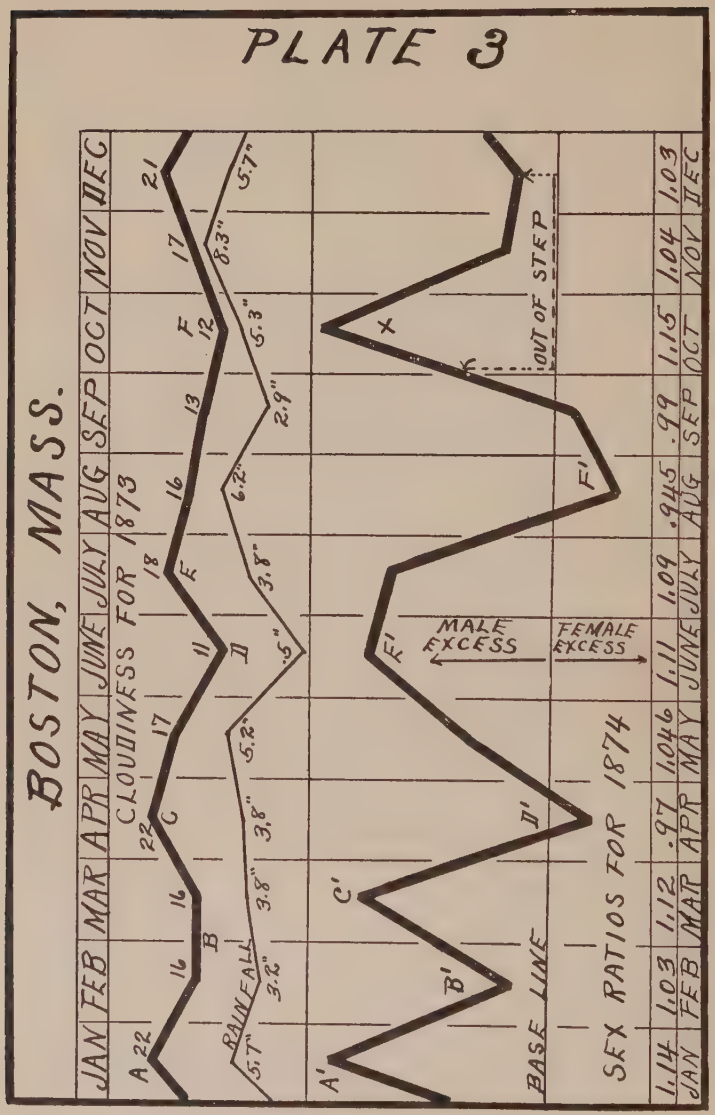
PLATE 3
BOSTON, MASS.
JAN FEB MAR APR MAY JUNE JULY AUG SEP OCT NOV DEC
CLOUDINESS FOR 1873
A 22 16 B 16 C 22 17 D 11 E 18 F 16 13 F 12 17 21
RAINFALL
5.7" 3.2" 3.8" 3.8" 5.2" .5" 3.8" 6.2" 2.9" 5.3" 8.3" 5.7"
A' B' C' D' E' F' BASE LINE
MALE EXCESS
FEMALE EXCESS
OUT OF STEP
X
F'
SEX RATIOS FOR 1874
1.14 1.03 1.12 .97 1.046 1.11 1.09 .945 .99 1.15 1.04 1.03
JAN FEB MAR APR MAY JUNE JULY AUG SEP OCT NOV DEC

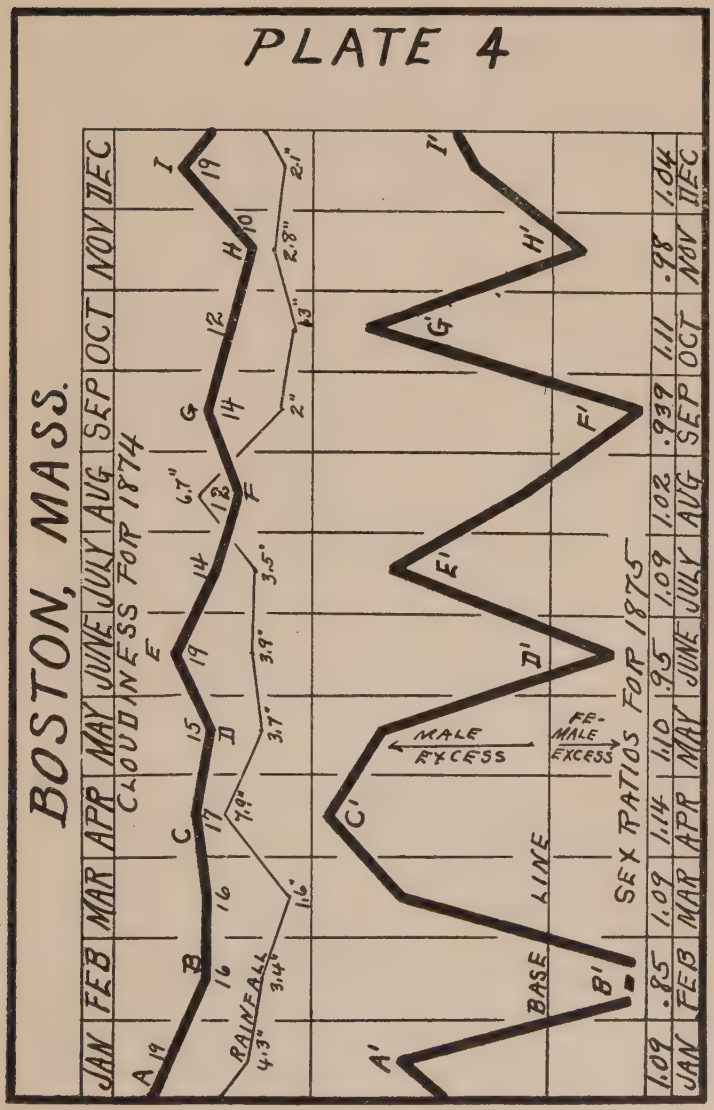
PLATE 4
BOSTON, MASS.
JAN FEB MAR APR MAY JUNE JULY AUG SEP OCT NOV DEC
CLOUDINESS FOR 1874
RAINFALL
4.3" 3.4" 1.6" 7.9" 3.7" 3.9" 3.5" 6.7" 2" 3" 2.8" 2.1"
A 19 B 16 16 C 17 15 D 19 E 14 18 F 14 G 12 10 H 19 I
A' B' C' D' E' F' G' H' I'
BASE LINE
MALE EXCESS
FE-MALE EXCESS
SEX RATIOS FOR 1875
1.09 .85 1.09 1.14 1.10 .95 1.09 1.02 .939 1.11 .98 1.04
JAN FEB MAR APR MAY JUNE JULY AUG SEP OCT NOV DEC

1871—Low male sex ratio, 1.039
1872—Low male sex ratio, 1.025
1873—Low male sex ratio, 1.021
1874—High male sex ratio, 1.056, the result of dehousing of female industrials the previous year, plus an unusual amount of shelter (owing to idleness ashore) for marine industrials (male), plus also an increased amount of outdoor activity for housewives in 1873 due to economic and psychological stresses.

81. Considering the total sex ratio for Boston for the entire eleven years, the male sex percentage is low—only 1.031. A low male sex ratio is common to much of the population of the New England States. It is relatively urban in its origin. Belgium and England also, for a long period prior to 1914 had been steadily developing a higher proportion of female births. This is due to concentrating population from which, in turn, arises increased housing and less sunlight for mothers, and more particularly due to the assembling of large contingents of women in definite indoor industries. The average ratio for Pittsburgh is about 1.07. For Detroit in 1914 it was 1.08. In these two cities there is but a negligible proportion of industrial employment for women, compared at least, to such cities as Lowell, Mass., or Carlisle, Pa.

82. The general appearance of the birth curve for both 1874 and 1875 (PLATES 3 and 4) is worthy of remark. What jagged oscillations from males toward females and vice versa! There can be little doubt that in taking on such a form it is responding to the abnormal conditions caused by the panic of 1873. It is very probable that if there were any opportunity to examine statistics for savage peoples, or to plot for such a sex ratio curve, these two curves would be good examples of what would be found. They are typical of a population without a fixed industrial habit.

83. The cloudiness curve for 1874 (PLATE 4) seems almost too nearly straight and smooth to be ad-

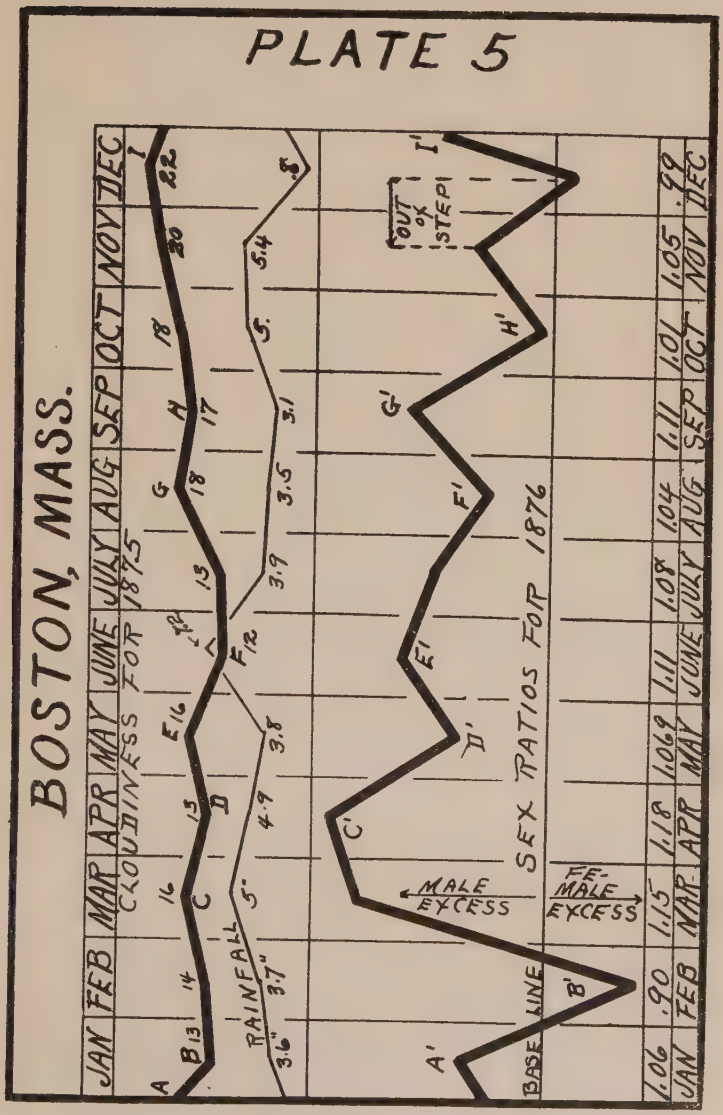
PLATE 5
BOSTON, MASS.
JAN FEB MAR APR MAY JUNE JULY AUG SEP OCT NOV DEC
CLOUDINESS FOR 1875
RAINFALL
3.6" 3.7" 5" 4.9 3.8 3.9 3.5 3.1
A B C D E F G H
13 14 16 15 16 12 13 18 17 18 30 22
SEX RATIOS FOR 1876
A' B' C' D' E' F' G' H' I'
BASE LINE
MALE EXCESS
FE-MALE EXCESS
OUT OF STEP
1.06 .90 1.15 1.18 1.062 1.11 1.08 1.04 1.11 1.01 1.05 .99
JAN FEB MAR APR MAY JUNE JULY AUG SEP OCT NOV DEC

mitted as a valid cause for the heavy fluctuations in the sex curve for 1875, but as before, it is here traced also point by point and it is found, regardless of shape, that the two pulsate in step without a failure throughout the twelve month period. Observe the smoothness and high altitudes of the cloudiness curve throughout the year 1875, (PLATE 5) and that through most of the year 1876 the birth curve remains unusually high. It dips to an excess of females only twice that year, in February and in December, and is out of step for only about 30 days at the close of the year.

84. PLATE 6. As mentioned before, (1) the cloudy year 1876 was largely the stimulus for this investigation of the weather factor, and it was found that June of that year had twenty-four cloudy days. Upon this basis I had at once, in 1916, prior to obtaining the figures, predicted the highest male sex ratio for Boston for some time in midsummer of 1877. A year later, the curve, as shown was developed from the birth statistics which I had received. It is out of step for a brief period in April and May but it jumps to 23% excess males in June. The synchronism is splendid for three-fourths of the year, in spite of the Centennial Exposition of 1876, which, by attracting thither many thousands of people, and thus interrupting their normal domestic and industrial habits, doubtless acted as an interference to some extent in the regular reactions of cloudiness.

85. PLATE 7. I have shown the cloudiness curve for 1877 and the sex ratio curve for 1878 sincerely believing that it will serve to remove all doubts from the minds of the incredulous if they will but inspect this parallel carefully. So final and conclusive is the relation which is shown by the curves that I have refrained from despoiling their beauty with any lettering. One is speechless with admiration, not alone for the two original curves, but also for the splendid triple parallel afforded by the rain curve. We should also refer here to the supplementary fact that by 1877 business conditions

Note (1) Par. 67.

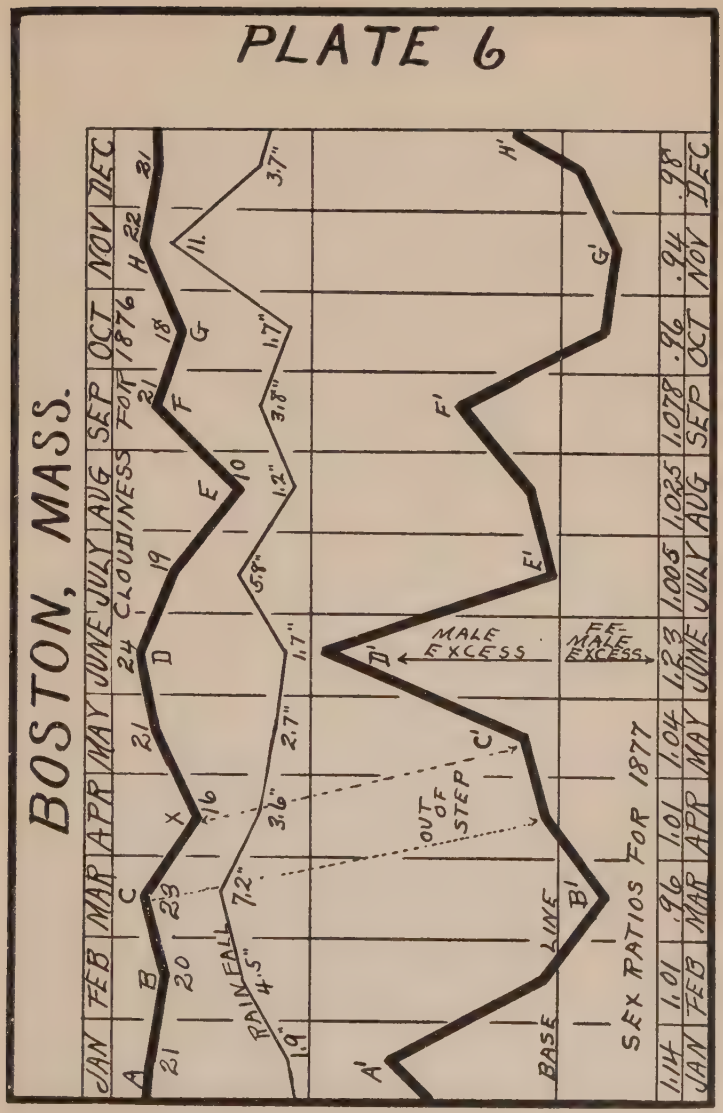
PLATE 6
BOSTON, MASS.
JAN FEB MAR APR MAY JUNE JULY AUG SEP OCT NOV DEC
CLOUDINESS FOR 1876
RAINFALL
4.5" 1.9" 7.2" 3.6" 2.7" 1.7" 5.8" 1.2" 3.8" 1.7" 3.7"
21 20 23 16 21 24 19 10 21 18 11 22 31
A B C X D E F G H
A' B' C' D' E' F' G' H'
BASE LINE
OUT OF STEP
MALE EXCESS
FE-MALE EXCESS
SEX RATIOS FOR 1877
1.14 1.01 .96 1.01 1.04 1.23 1.005 1.025 1.078 .96 .94 .98
JAN FEB MAR APR MAY JUNE JULY AUG SEP OCT NOV DEC

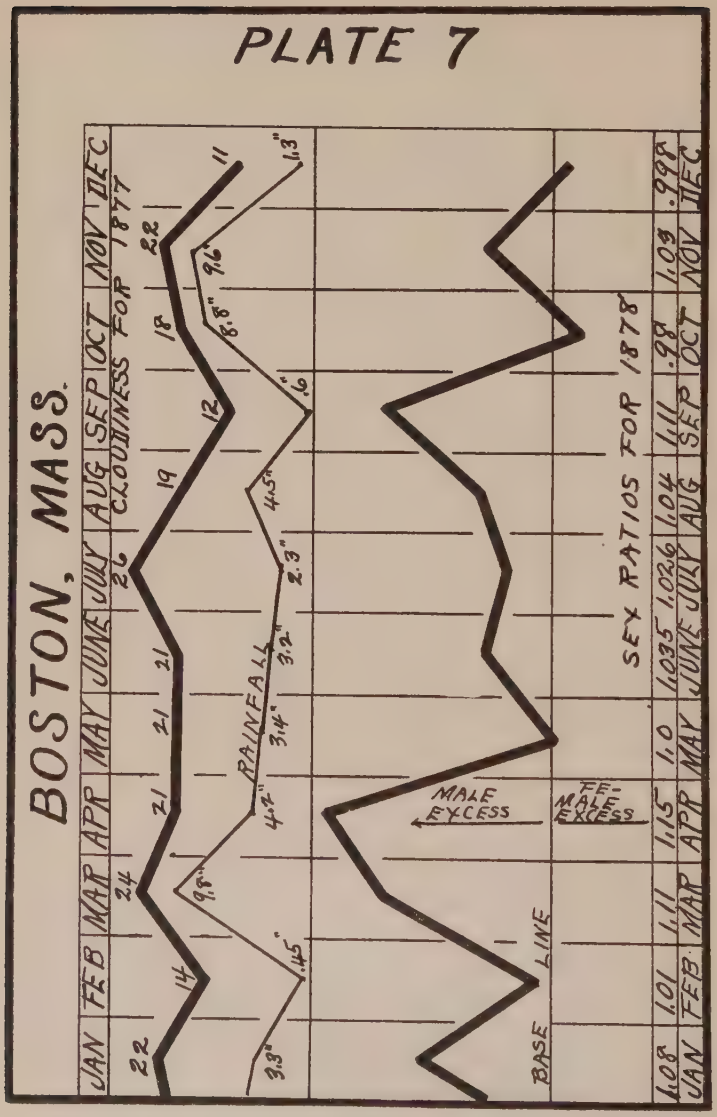
PLATE 7
BOSTON, MASS.
JAN FEB MAR APR MAY JUNE JULY AUG SEP OCT NOV DEC
CLOUDINESS FOR 1877
22 14 24 21 21 26 19 12 18 22 11
PAINFALL
3.9" .45" 1.8" 4.2" 3.4" 3.2" 2.3" .6" 8.8" 9.6" 1.3"
BASE LINE
MALE EXCESS
FE-MALE EXCESS
SEX RATIOS FOR 1878
1.08 1.01 1.11 1.15 1.0 1.035 1.026 1.04 1.11 .98 1.09 .998
JAN FEB MAR APR MAY JUNE JULY AUG SEP OCT NOV DEC

were improved. Industrial groups of every class were once more active and regularity in the habits of the people was again becoming established.

86. In presenting plates 8 to 11, perhaps little comment will be necessary. Without statistics for 1909-10 we are not positive that A-A′ (PLATE 8) are the beginnings of synchronous relation here, but if they are, this is the first time that any reaction of fourteen months length has been found. From May until December the synchronism is almost a miracle, the reactions being twelve months at every point.

87. Despite a wild dissimilarity in the shapes of the curves on PLATE 9, there follows the beautiful synchronism as lettered from January to December. One should note how the steady cloudiness of 1911, in general, forces up the excess male birth rate toward the end of 1912 in a huge volume five months long. For eight months in 1912, April, May, June, August, September, October, November and December, the male sex ratio is up to normal or far exceeds it. A precipitation of 4.6 inches of rainfall in July reinforces eighteen days of cloudiness in the preceding month with the result of a 15% excess of males born the following May (1912).

88. For thirty days, in June and July, PLATE 10, the birth curve falls out of step (X-X′) with the cloudiness curve, but again in December, the two are back in step. PLATE 11 shows complete synchronism through out the twelve month period. The close triple parallel afforded by the rain curve is again remarkable. It does not seem that the curve of rainfall is inclined to follow that of cloudiness very frequently, strange as the fact may appear, but when it does so a profound effect upon the sex ratio curve is the result.

89. If, out of eleven pairs of curves, only one or two could be found to uphold the hypothesis which I have set up, there might be a justifiable temptation to dismiss them as merely coincidental, but when seven pairs, PLATES 1, 2, 4, 6, 7, 8, and 11, and more particularly

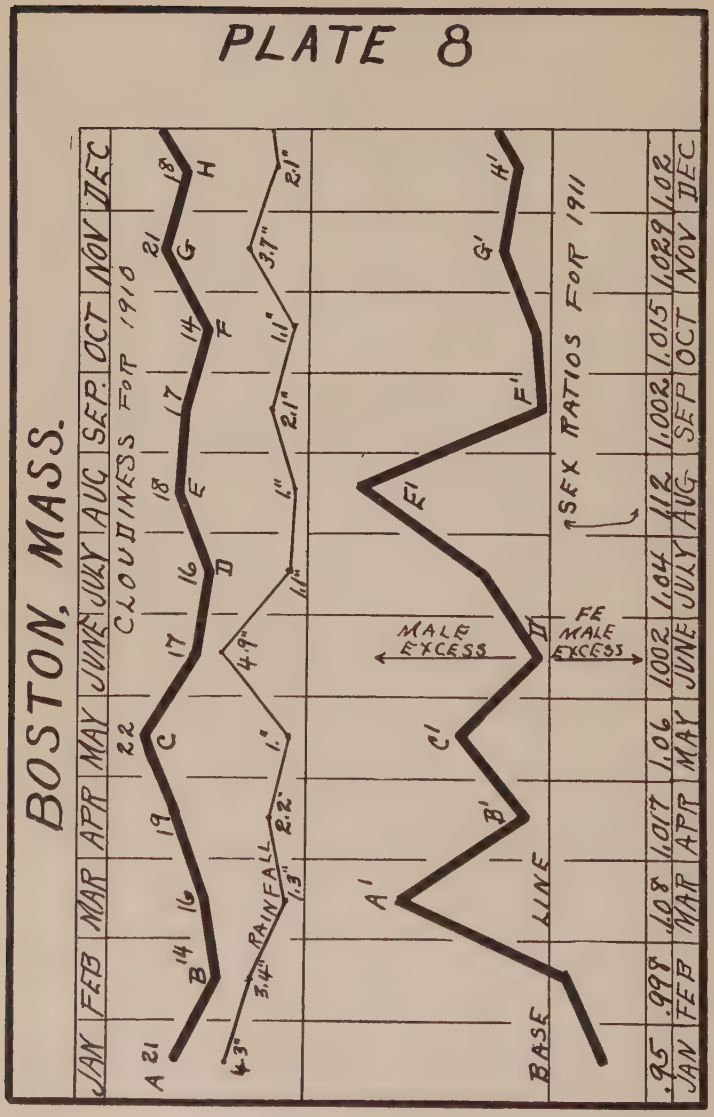
PLATE 8
BOSTON, MASS.
JAN FEB MAR APR MAY JUNE JULY AUG SEP. OCT NOV DEC
CLOUDINESS FOR 1910
A 21
B 14
16
19
C 22
17
D 16
E 18
17
F 14
G 21
H 18
4.3"
3.4" RAINFALL
1.3"
2.2"
1."
4.9"
1.1"
1."
2.1"
1.1"
2.1"
3.1"
2.1"
BASE LINE
A'
B'
C'
D'
E'
F'
G'
H'
MALE EXCESS
FE MALE EXCESS
SEX RATIOS FOR 1911
.995 JAN
.998 FEB
1.008 MAR
1.017 APR
1.06 MAY
1.002 JUNE
1.044 JULY
1.12 AUG
1.002 SEP
1.015 OCT
1.029 NOV
1.02 DEC

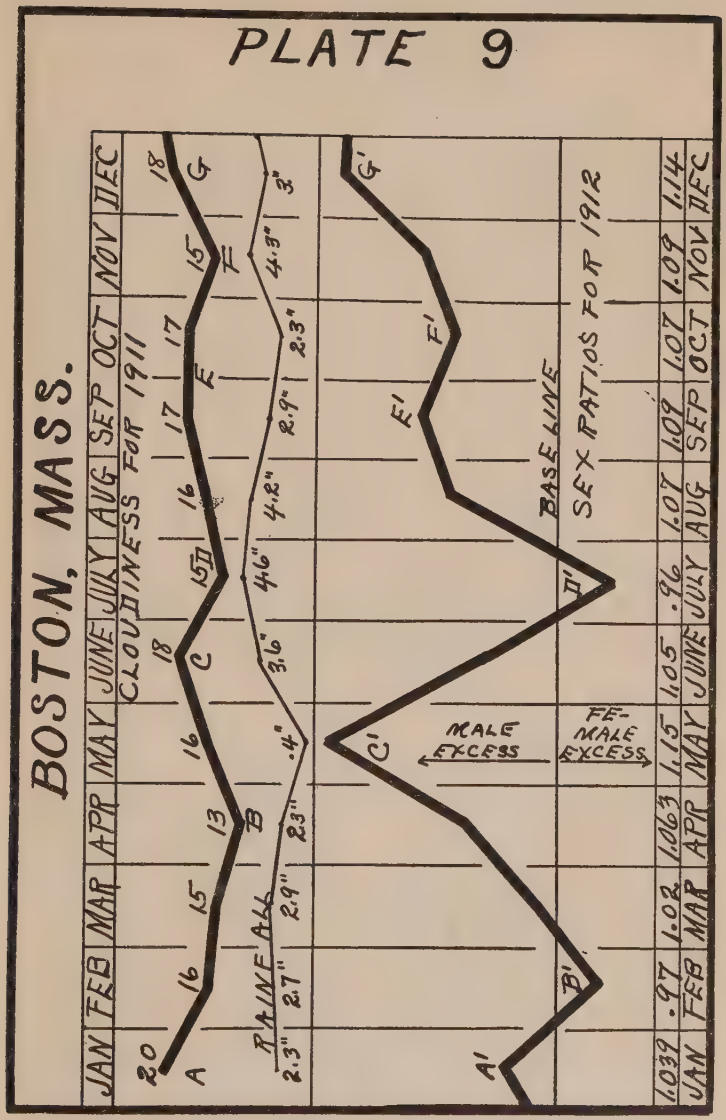
PLATE 9
BOSTON, MASS.
JAN FEB MAR APR MAY JUNE JULY AUG SEP OCT NOV DEC
CLOUDINESS FOR 1911
RAINFALL
2.3" 2.7" 2.9" 2.3" .4" 3.6" 4.6" 4.8" 2.9" 2.3" 4.3" 3"
20 16 15 13 16 18 15 16 17 17 15 18
A B C D E F G
A' B' C' D' E' F' G'
MALE EXCESS
FE-MALE EXCESS
BASE LINE
SEX RATIOS FOR 1912
1.039 .97 1.02 1.063 1.15 1.05 .96 1.07 1.02 1.07 1.09 1.14
JAN FEB MAR APR MAY JUNE JULY AUG SEP OCT NOV DEC

BOSTON MEDICAL
FEB 28 1930
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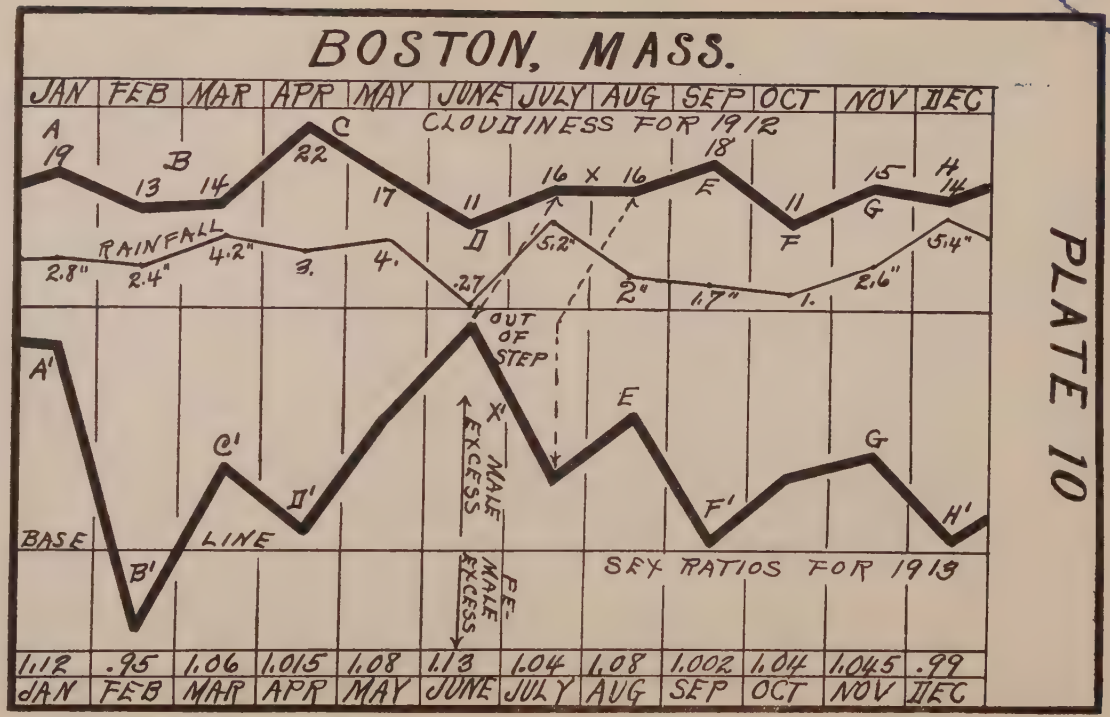

PLATE 10

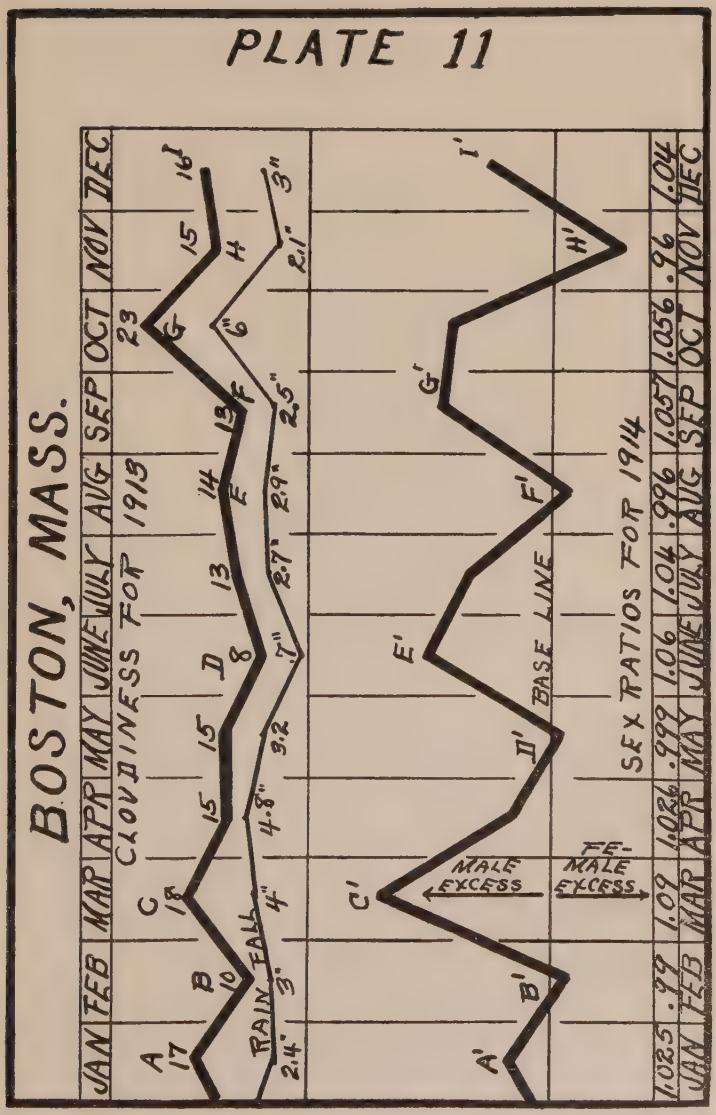
PLATE 11
BOSTON, MASS.
JAN FEB MAR APR MAY JUNE JULY AUG SEP OCT NOV DEC
CLOUDINESS FOR 1913
RAIN FALL
2.4" 3" 4" 4.8" 3.2" 3" 2.7" 2.9" 2.5" 2.1" 3"
A 17 B 10 C 18 15 15 D 8 13 E 14 F 19 G 23 15 H 16
A' B' C' D' E' F' G' H' I'
MALE EXCESS
FE-MALE EXCESS
BASE LINE
SEX RATIOS FOR 1914
1.025 .99 1.09 1.024 .999 1.06 1.04 .996 1.057 1.056 .96 1.04
JAN FEB MAR APR MAY JUNE JULY AUG SEP OCT NOV DEC

those on Plates 2, 7, 8, and 11, show such close and regular synchronism, I feel justified in contending that we have here a definite relation between sunlight and the processes of sex differentiation in the germ cell which can no longer be ignored.

90. At five points in the Boston curves, (PLATES 1, 3, 5, 6, and 10) are shown short periods during which the sex ratio curve is out of step, thirty, eighty, thirty, thirty, and thirty days, respectively, totalling two hundred days. This means that the curves lack only 4.9% of being totally synchronous for the entire eleven years. I believe that even the small percentage of 4.9 will yet be eliminated because in checking up the total number of individual peaks and depressions in the upper and lower curves a more remarkable state of affairs exists than has yet been encountered.

91. In the cloudiness curve for eleven years there are forty-seven peaks and there are forty-six peaks for the same time in the sex ratio curve. Similarly there are forty-six depressions in the cloudiness curve and the same number in the sex ratio curve. This comprises all of the curve, even including the portions indicated "out of step."

92. One strong characteristic worthy of remark is a definite tendency toward an excess of females early in the year. For eight years out of eleven it is in February. For two years it occurs in March; and in one year, (1911, PLATE 8), it probably occurred in January. For eight years there is definitely a peak of male births in January. For one year, (PLATE 9), it occurs in December and it probably occurred during the preceding December for PLATES 1 and 8.

93. One may here catch a glimpse of the intrinsic nature of the sex potential which he can ill afford to miss. In dealing with the cloudiness curve for 1871 and its mate, the sex ratio curve for 1872, it is readily seen that cloudiness forms more nearly a true curve, smooth and gentle. The cloudiness peak C for March and April

is a broad peak rolling up gradually over these two months. Then, suddenly, the sex ratio curve flashes back across the base line to an excess of males at C′ in April, 1872 and for June and July (E-E′) the phenomenon is repeated in precisely the same manner. This type of reaction may easily be traced at many other points on the eleven plates.

94. What interpretation will be placed upon it? Simply this, I believe, that continued cloudiness usually produces a cumulative effect upon the human sex economy. This means, reciprocally, that the sex economy possesses inertia, a property, by virtue of which, it resists being moved or changed. It thus tends to remain in a given condition until the opposing force becomes overwhelming; then it gives way suddenly and moves to the other extreme of potential with a great drive as a rubber band, when released after being held taut.

95. Throughout the Boston curves it has been noted constantly that reactions do not always occur in exactly twelve months time; (1) sometimes they speed up (accelerate) and react in eleven, ten, or even nine months time. Again they slow down (lag), some being thirteen or even fourteen months long. This is a leverage of which I shall take advantage to make the curves prove themselves truly indicative of cause and effect. If it is found that reactions in different pairs of curves tend to slow down or speed up a similar number of times for the twelve month period it will be brought out as favorable evidence.

96. Taking the two original curves shown on PLATE 2, PLATE 12 is constructed. A convenient base line, YZ is drawn. The reaction A-A′ appears to indicate twelve and one-half months time, therefore the point A″ is located one-half space above the base line. B-C-D and B′-C′-D′ are all regular reactions twelve months apart, therefore this is shown by points B″-C″-D″ exactly on the base line. E reacts at E′ eleven months later and the point E″ on the new curve is located one space below the

Note (1) Alluded to briefly in Par. 72.

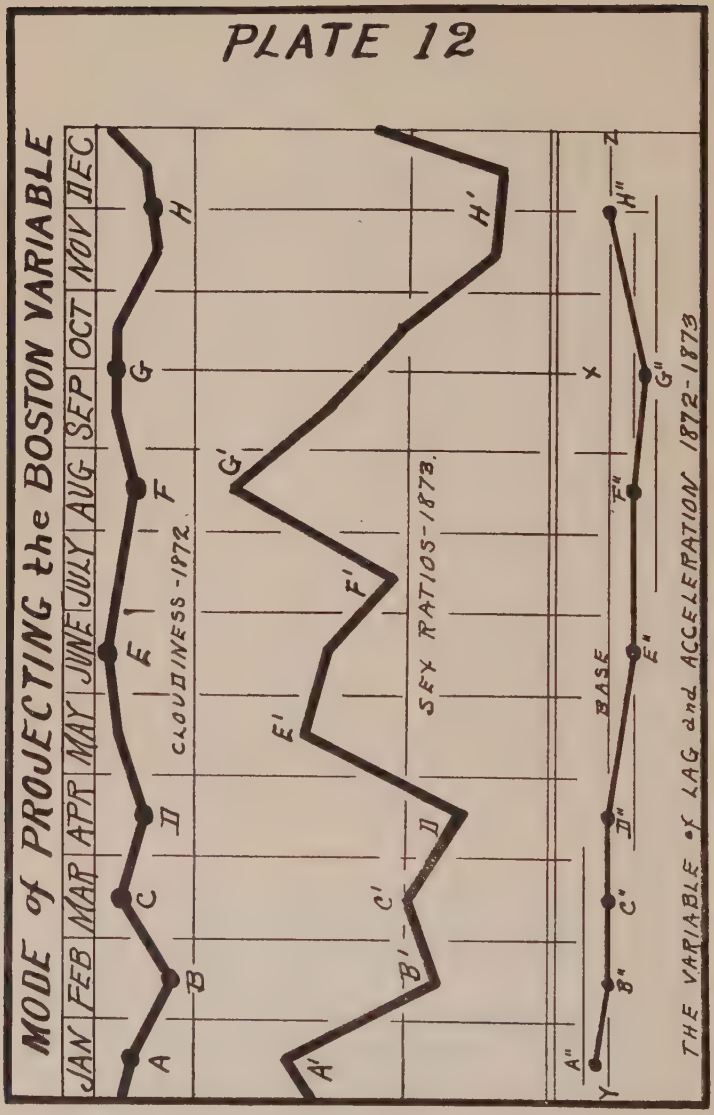
PLATE 12
MODE of PROJECTING the BOSTON VARIABLE
JAN FEB MAR APR MAY JUNE JULY AUG SEP OCT NOV DEC
A B C D E F G H
CLOUDINESS-1872.
A' B' C' D' E' F' G' H'
SEX RATIOS-1873.
A" B" C" D" E" F" G" H"
X Y Z
BASE
THE VARIABLE of LAG and ACCELERATION 1872-1873

base line. Another reaction eleven months long gives F″ one space below the base line. G-G′ is a ten and one-half months reaction (acceleration increasing) and gives G″, one and one-half spaces below the base line. By the end of the year reaction is slowing down again to twelve months, H-H′, and for the point H″ on the new curve a return is made to the base line. Connecting all these newly developed points gives a third curve which shows a reaction slow in January but increasing in speed until about October first when it turns and again slows down in December. Thus there is one dip in the new curve, A″-G″-H″, with G″ its lowest point. This I have called a "variable of lag and acceleration."

97. Similarly, on PLATE 13, I have constructed a variable for each of the original Boston pairs, (PLATES 1 to 11). All of these new test curves which dip and rise the same number of times each year may be termed "iso-variables of lag and acceleration". On PLATE 13 there are four iso-variables in the first group which dip once during the year, (at X) and return. In the second group there are four more, each of which dips twice during the year and returns to the base line or in the direction of it. There are three in the third group which are of odd shape and which do not fall within either of the first two classes. I have thus succeeded in producing an adequate picture of the phenomenon of lag and acceleration, and it will be seen that it tends to recur in the same fashion in different years. Without doubt this verifies the conclusion of recurrent cause and effect in the original pairs of curves. (1)

98. In PLATE 14 I have given the perennial curves of cloudiness, rainfall, and sex ratios. The earlier curves were plotted month by month. These latter are constructed on annual totals. Here annual sex ratios follow the cloudiness curve from 1872 to 1876. The annual sex ratios broke with the cloudiness curve and then fell into

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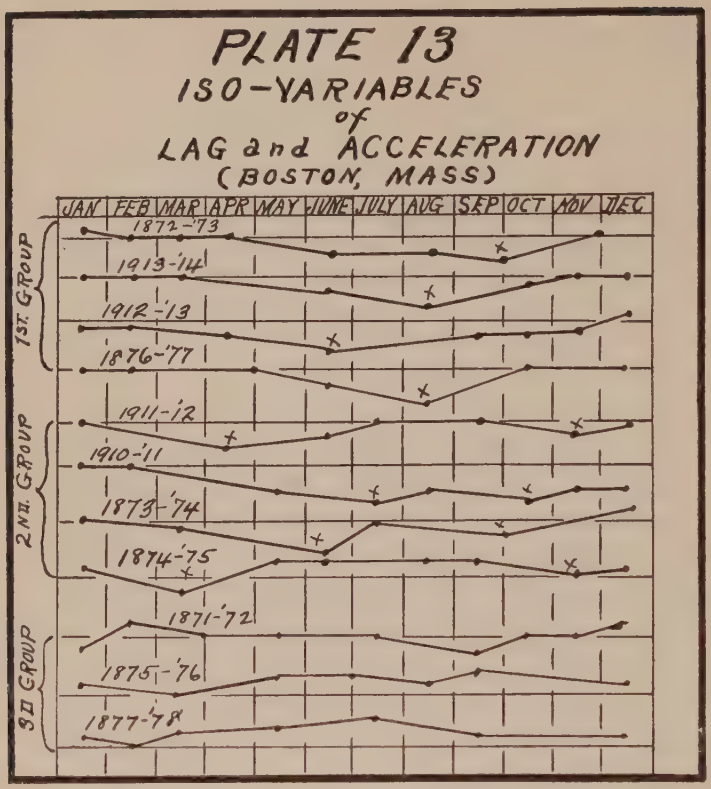
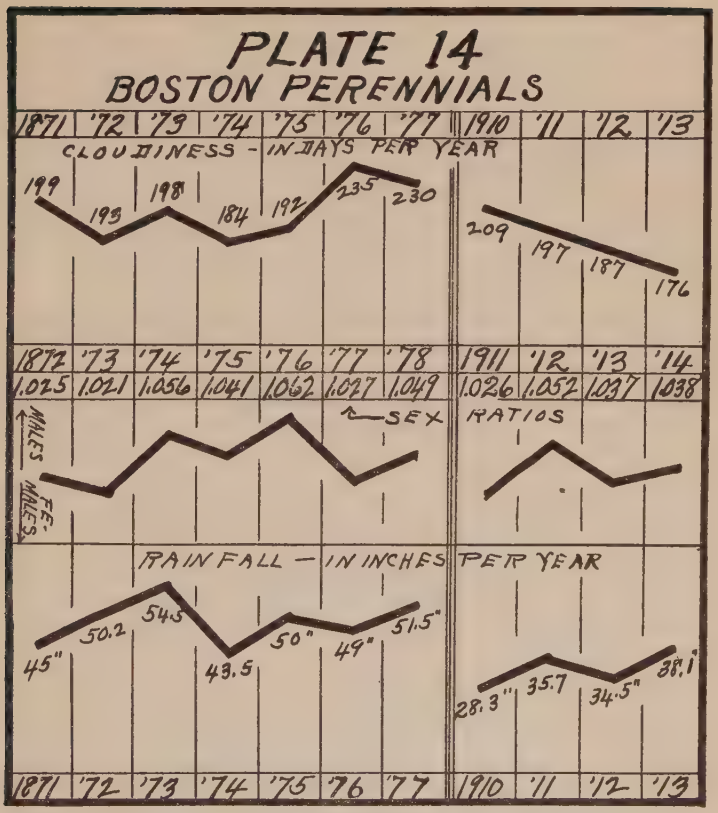
Note (1) In locating the points for plotting the variables, I was governed by the points in the original cloudiness curve. E. g. (PLATE 12) G-G′ is ten and one-half months and G, on the base line, is located at X, exactly underneath G of October first.



step with that of rainfall. Through 1911-12-13-14 the sex ratio curve refused to pulsate annually with cloudiness, but it followed the curve of rainfall. Since the monthly variations previously studied must be considered as superposed upon the perennial plottings, with out any interfering effects, no serious difficulty is faced in the lack of perfect synchronism here. From 1911 to 1914 there is no relation whatever between annual points of cloudiness and annual positions of the sex ratio curve. In the graphic work which follows there will be found strong indications that sex ratios tend to respond in their variations preferably to that weather factor which shows most violent fluctuations, whether it be rainfall or cloudiness. In this case there is only a gentle gradient



in cloudiness from 1910 to 1913. It is in the rain curve for the same period that the violent fluctuations occur.

99. Concerning rainfall in itself, to which several references have been made, we may consider that rainfall enters as an influencing factor to just that extent by which it imposes excessive and unusual housing upon one sex or the other, or, perhaps upon some one definite industrial group, either males or females; the effect being that the direction of increase in the birth ratio will favor that sex which collectively enjoys the greatest and most sudden housing by virtue of the inclement outdoor conditions.

100. On PLATE 1 there were thirty days out of step with cloudiness. But this period is moving upwards with a sudden increase of rainfall in February and March of the year before. From March to June the rain curve is steady. The heavy fluctuations are in cloudiness. From July to November rain is fairly well proportioned with cloudiness and sex ratios are satisfactorily proportioned also. With December comes a heavy dip in rainfall and the same occurrence is to be noted in sex ratios. One is left to conjecture as to whether H and H′ are really related, or whether 3. 4″ rain and H′ are the true relative points.

101. On PLATE 2 the proportion between rain and cloudiness is quite admirable except at 10.7″-F, in August. Here they intersect. The result is brilliant, however, for the rainfall of 10.7 inches is actually in parallel or reenforced by the nineteen days of cloudiness of the following month and G′ answers the combination. Here the protection for fathers indoors was enforced by rainfall in August. In September rainfall dropped almost 40% but cloudiness increased and their shelter outdoors continued thereby.

102. On PLATE 3 the triple parallel reads: A-5.7″-A′. B-3.2″-B′. C-5.2″-C′. D-5″-D′. E-6.2″-E′. F-2.9″-F′, and, if one choose, 21-8.3″-X. The last reading however, would create confusion with the asynchronous portion of sex ratios eighty days long, hence the end of the year must be omitted. This condition is due no doubt to the causes described before. (1)

103. In studying PLATE 4 one cannot avoid the strong impression that through the middle of the year sex ratios are answering more satisfactorily to rainfall. At the end of the year G-G′, H-H′, and I-I′ show a restoration of cloudiness as the governing factor through a flattening of the rain curve.

104. PLATE 5 shows thirty days in sex ratios, (in November and December), out of step with cloudiness

Note (1) Par. 79.

but it is not out of step with rainfall. The smooth gradient H-I in cloudiness is replaced by heavy fluctuations, 3.1″, 5.0″, 0.8″, in rainfall.

105. It is more probable on PLATE 6 that all the cloud values, high in January, February, and March, combine with 7.2″ rain in March to react at A′ in 14% excess of males. Certainly 7.2 inches of rain in March would be sufficient to counterbalance a drop of only one day in cloudiness at B. Under this analysis X is the point which really reacts at B′. Thus, after all, the thirty days asynchronism is only superficial. The reading for the remainder of the twelve months is satisfactory, beginning D-5.8″-D′.

106. The beautiful result of PLATE 7, combining the rain curve as well, would indeed be marred by any detailed discussion. It will be permitted to stand on its own merits. Little satisfaction is found in attempting to trace rainfall relativity in the case of PLATE 8. There are very few values of any magnitude in this rain curve, if it is compared with those on PLATES 7 or 6.

107. Apparently on PLATE 9 the reading is: A-2.9″-A′. B-0.4″-B′, C-4.6″-C′, D-D′, E-E′, F-F′, G-G′, giving a triple reading on the first three points and only a double reading, (the original) for the last three points. These three, in the rain curve 2.3″, 4.3″, and 3.0″, as will be observed are exactly opposed in their directional values to the three in the cloudiness curve, E, F, and G.

108. In PLATE 10 some difficulty is encountered. Beyond question there is a short period here at which the sex ratio curve falls out of step with cloudiness. Whether it is correctly shown between July and August and June and July may be a debatable matter. The form of the rain curve in January and February is neutral. There is a three-month period of higher values, 4.2″, 3″, and 4″, in April, May, and June. Since the cloudiness curve, in form, is neutral through July, August and September, and the heavy fluctuations occur in the rain curve, it is probable that the rain curve alone governs

for a short period at about the time that asynchronism was noted between cloudiness and sex ratios. Summing up these detailed considerations, the following readings may be tried: A-A′, B-B′,

$$C\left\{\begin{matrix}4.2''\\3.0''\\4.0''\end{matrix}\right\}C'$$

D-0.27″-D′, 5.2″-X′, E-E′, F-F′, G-G′, H-H′. PLATE 11 is self evident.

109. In closing the treatment of the Boston curves we should not go to the study of other material on the case with any disproportionate idea of the extent to which meteorological conditions effectively impress themselves upon human reproductive phenomena in terms of sex differentiation. There were 874 births in Boston in June 1877 and out of this total, the peak D′, PLATE VI, represents an excess margin of only 92 male births, only about fifteen per cent of the total.

110. Reference has been made to the question as to why all the curve points in weather conditions seem to react on the sex ratio curve at intervals averaging twelve months long, in the face of the fact that the period of human gestation is only nine months long. (1) This is a very natural question which I have asked myself many times. It is a fact, the exact reason for which cannot yet be shown but which points to a condition of affairs somewhat of this nature: apparently the germ cell is not primarily reached by the rays of solar energy, but light, falling upon the body, sets up in the superficial layers of body cells, the essential change, (or metabolism) whatever its nature may be, and this is successively transmitted at a lessened rate of speed to every cell in the body, including the reproductive germs. Thus also it would appear that it requires an average time of three months for each successive wave of metabolism to reach and affect the human gamete, following the impact of any critical condition of sunlight upon the exterior of the body.

Note (1) Par. 72.

111. There are in physical science many facts and phenomena of practical use, the real intrinsic nature of which we know but little. For about eighty years we have made practical use of electricity and magnetism and have compelled these mighty agents to meet our needs and dictates, but there is very little known of their exact character. It is assumed to be of a certain nature because the manifestations of these agents seem to warrant such conclusions. It is upon such ground as this alone that speculative answer has been offered relative to the question raised in the preceding paragraph.

Note: The word "metabolism" has been frequently used, thus far, simply because of the lack of any more precise term for referring to cellular processes of structural or bio-chemical alteration. Until we learn the precise nature of these changes, or as long as they remain vague—just so long will our terminology on this point also remain vague. (See also Par. 56.)

CHAPTER IV

Other Evidences on the Case for Meteorological Relativity

112. While we have already had our first introduction to the factor involved in rainfall (Par. 99), it still remains to trace it more definitely. Before finding evidence upon the subject the hypothesis was first conceived that it should serve, in many localities, as the index for quantitive housing either for one sex or for the other: that in some agricultural regions sex ratios in births might be found to parallel the curve of rainfall, and that the peaks of female births might follow the peaks of rainfall, since the amount of housing for farm mothers is more nearly proportional to the rainfall than to any other measurable factor. It was obvious that, to secure an example of this, it would be necessary to look to some county in which the population was nearly all rural and the county seat small. Mercer county, Ohio, and Preble county, adjoining Mercer on the south were the first units examined and they answered this specification immediately. The results for these two units of territory in rainfall for 1915 and sex ratios for 1916 are shown by PLATES 15 and 16, in which the related points are similarly lettered. Here the precipitation of one year is followed by an excess of, or by an increased proportion of females in births, and, reacting against seasons of drouth, (excessive outdoor habits for mothers), the curves move back towards male births (1)

113. PLATE 17 gives, first, the cloudiness curve for Indianapolis, Indiana, for ten years, 1907 to 1916 (2). The second curve is that of the sex ratios, 1908 to 1917. The fourth, or lowest, is the curve of rainfall with

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Note (1) I originally plotted for 1913-14, 1914-15, and 1915-16 for both counties. The synchronism was very favorable in the first two periods, but comes to its highest perfection in PLATES 15 and 16. The parallel on PLATE 15 is marvelous.

Note (2) I have plotted here only the top edge of the whole curve, i. e. that portion lying between the years of minimum and maximum cloudiness.

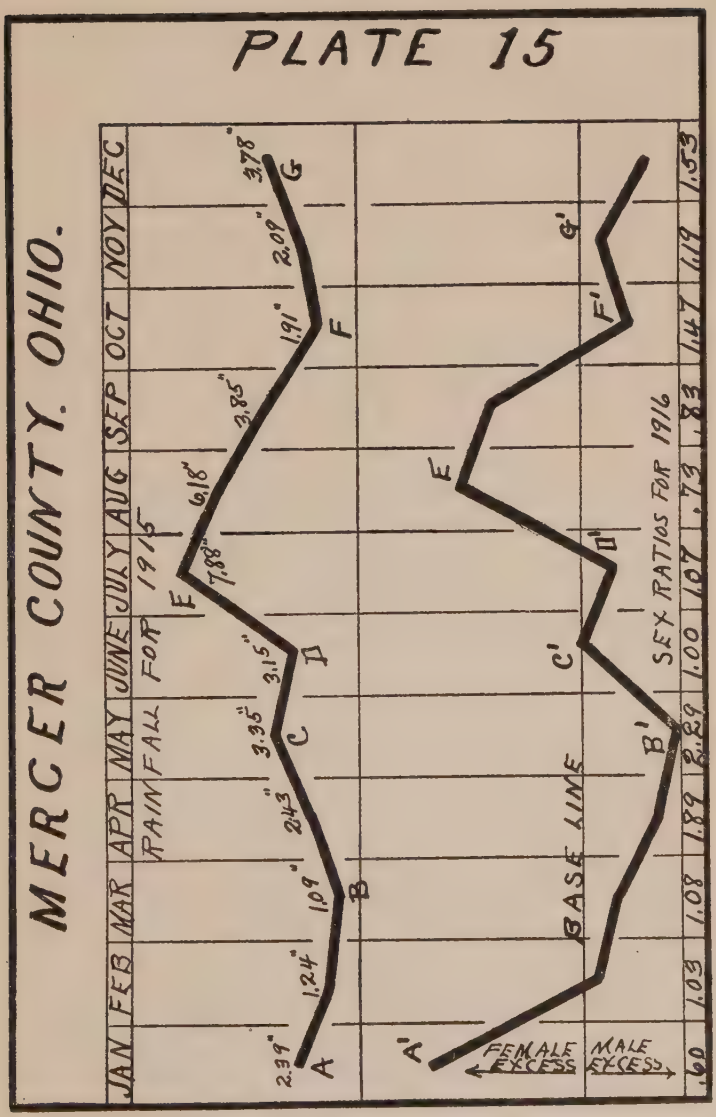


PLATE 15
MERCER COUNTY. OHIO.
JAN FEB MAR APR MAY JUNE JULY AUG SEP OCT NOV DEC
RAINFALL FOR 1915
2.39" 1.24" 1.09" 2.43" 3.35" 3.15" 7.88" 6.18" 3.85" 1.91" 2.09" 3.78"
A B C D E F G
A' B' C' D' E' F' G'
BASE LINE
FEMALE EXCESS
MALE EXCESS
SEX RATIOS FOR 1916
.60 1.03 1.08 1.89 2.89 1.00 1.07 .73 .83 1.47 1.19 1.53

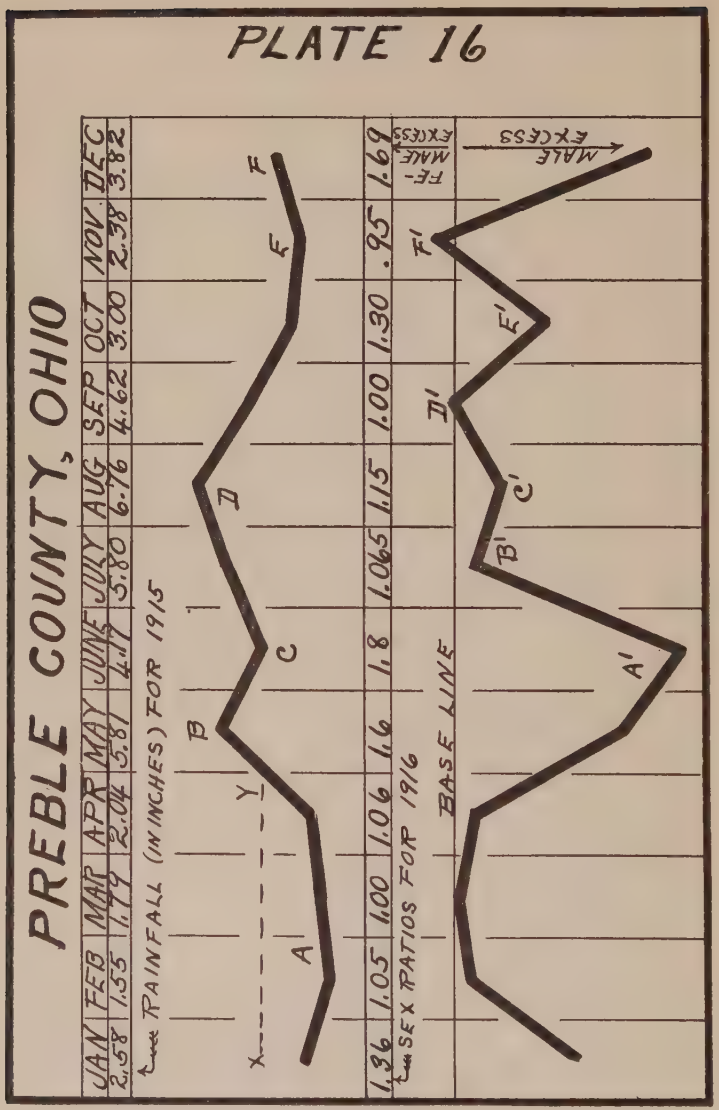


PLATE 16
PREBLE COUNTY, OHIO
JAN FEB MAR APR MAY JUNE JULY AUG SEP OCT NOV. DEC
2.58 1.55 1.79 2.04 3.87 4.17 5.80 6.76 4.62 3.00 2.38 3.82
RAINFALL (IN INCHES) FOR 1915
1.36 1.05 1.00 1.06 1.6 1.8 1.065 1.15 1.00 1.30 .95 1.69
SEX RATIOS FOR 1916
FE-MALE EXCESS
MALE EXCESS
BASE LINE
A B C D E F
A' B' C' D' E' F'

a base line itself of an altitude of sixteen inches of precipitation. From strong indications which had preceded, I was led in the case of Indianapolis, to create an artificial compound curve by the process of multiplying each value in inches of rainfall by the number of days cloudiness in the same year, thus 218 (days cloudy, 1907) times 38.5 (inches of rainfall in the same year) =8393. By this process the compound weather curve, the third from the top was constructed, year by year, and the product of each multiplication is shown by the figures along the curve. Here the sex ratio curve is asynchronous with the cloudiness curve at X-X′, 1911-12, but the sex ratio curve is in full synchronism with the rain curve, reading throughout the whole ten years, "Rainfall and males", "Drouth and females".

When, as shown, the number of days of cloudiness, (outdoor protection for fathers), is multiplied by inches of rainfall, (the index of indoor shelter for fathers), the result in the compound curve is a parallel of miraculous similitude. Here too, is shown the logical contrast between a city and the rural district in the relation of rainfall. It was not possible to develop a compound in the case of Boston such as that for Indianapolis.

114. PLATE 18, while affording some satisfaction for Minneapolis, Minnesota, is not void of one phase of speculation. Here the cloudiness curve for ten years, 1903 to 1912, is shown with the sex ratio curve in births for a like period, 1904 to 1913. From 1903 to 1907 there is no similitude in the shapes of these two. Then suddenly, in the middle of 1908, the sex ratio curve breaks into an active series of oscillations responding perfectly to those of the cloudiness curve. It should be remembered, in this connection, that the financial stringency of 1907 was much more seriously felt by the western cities than by those in the east. That it did prove disturbing to the industrial equilibrium of the city of Minneapolis is

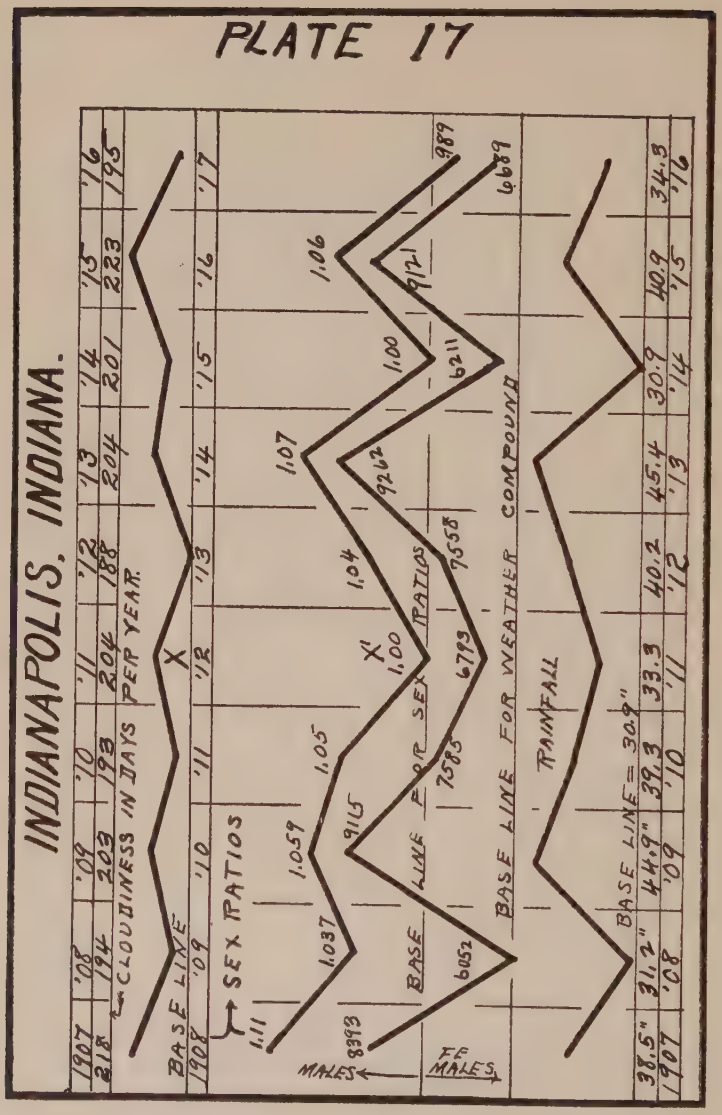
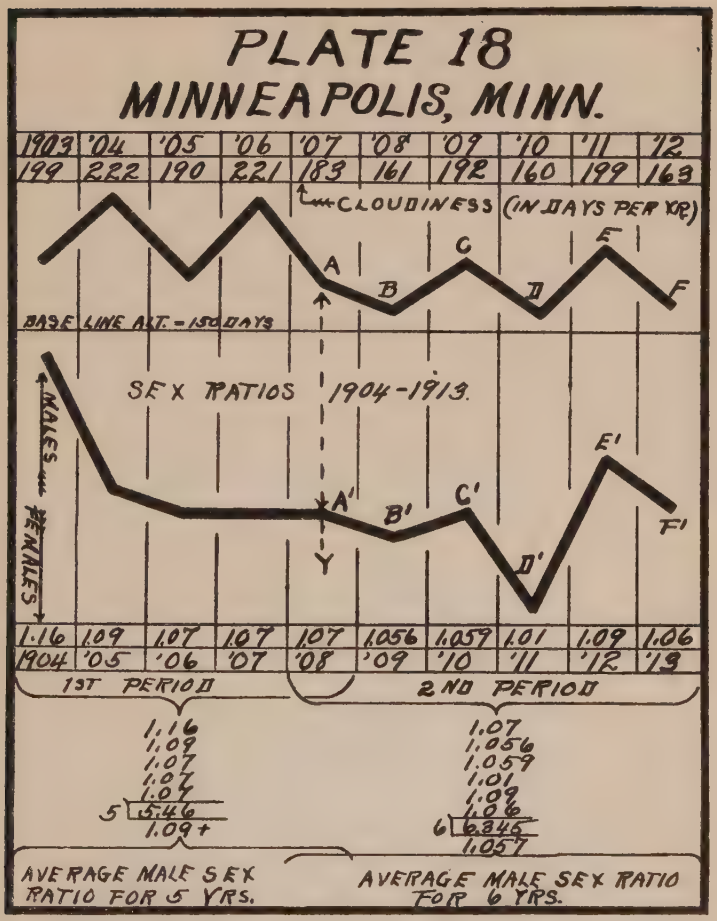


PLATE 17
INDIANAPOLIS. INDIANA.
1907 '08 '09 '10 '11 '12 '13 '14 '15 '16
218 194 203 193 204 188 204 201 223 193
CLOUDINESS IN DAYS PER YEAR.
BASE LINE
1908 '09 '10 '11 '12 '13 '14 '15 '16 '17
SEX RATIOS
1.11
1.037
1.059
1.05
9115
1.04
9262
1.07
1.00
9121
1.06
989
MALES
8393
BASE LINE FOR SEX RATIOS
6052
7585
6773
7558
6211
6689
FEMALES
BASE LINE FOR WEATHER COMPOUND
RAINFALL
BASE LINE = 30.9"
38.5" 31.2" 44.9" 39.3 33.3 40.2 45.4 30.9 40.9 34.8
1907 '08 '09 '10 '11 '12 '13 '14 '15 '16



evidenced by a statement (1) in the annual report of the special truant officer of the city schools, for the year ending June 1, 1908. This discloses the immediate and high probability that the sex ratio curve from 1904 to 1908 is a fair index to a general economic curve for that city from 1903 to 1907.

Note (1) "An increase over the year 1907 of 295 applications (for employment for school children) and of 116 certificates issued, is shown. This was caused by the dull times following the late financial stringency which threw a good many adult wage earners temporarily out of work during which time positions to work could be more easily secured for school children."
(Signed) J. W. Ashworth, Spec. Truant Officer.

115. I exhausted every resource to obtain data for a general economic curve for Minneapolis but was unsuccessful. Neither statistics on artificial gas production nor street railway fares were sufficiently void of psychological disturbances. I was also unable to secure data on delinquent city water dues. I thought that a per capita computation of special employment cases for school children would afford basis for an economic curve, but this data proved to be irregular and somewhat unsystematic. Moreover, the figures for one year were missing, hence the search for an economic index became exasperating.

116. There is, however, in the report mentioned above, the positive evidence that following 1907 wage earners were walking the streets. In order to see the statistical result the births of these two periods, including 1908, the transition year, should be divided. This gives for the first period of good times and housed fathers a 9% excess of male births, and for the second period of hard times and fathers undergoing outdoor exposure, but 5.7% excess of male births, (an increase in the proportion of females born.)

117. Discovering finally, for Minneapolis, statistics on post office receipts in cash, I plotted the curve on PLATE 19, thinking that it would prove to be the much sought economic index. I was completely nonplussed, however, when, in comparing it with the sex ratio curve, I found it necessary to invert the latter to obtain a parallel, which, as shown, is very fair. (1) The readings are: A-A′, "low post office receipts and males;" B-B′, "high post office receipts and females." Can one believe it possible when business is stagnant and fathers are walking the streets, and an excess of female births is being induced, that post office cash receipts are moving up to peak? There is no other conclusion. I talked with the Assistant Postmaster of the city, and with the bookkeeper of the largest mercantile concern in Minneapolis, and each, without knowledge of the

Note (1) Here are given female sex ratio decimals, while those given on PLATE 18 are male sex ratios. (For the distinction, see note with Par. 64.)

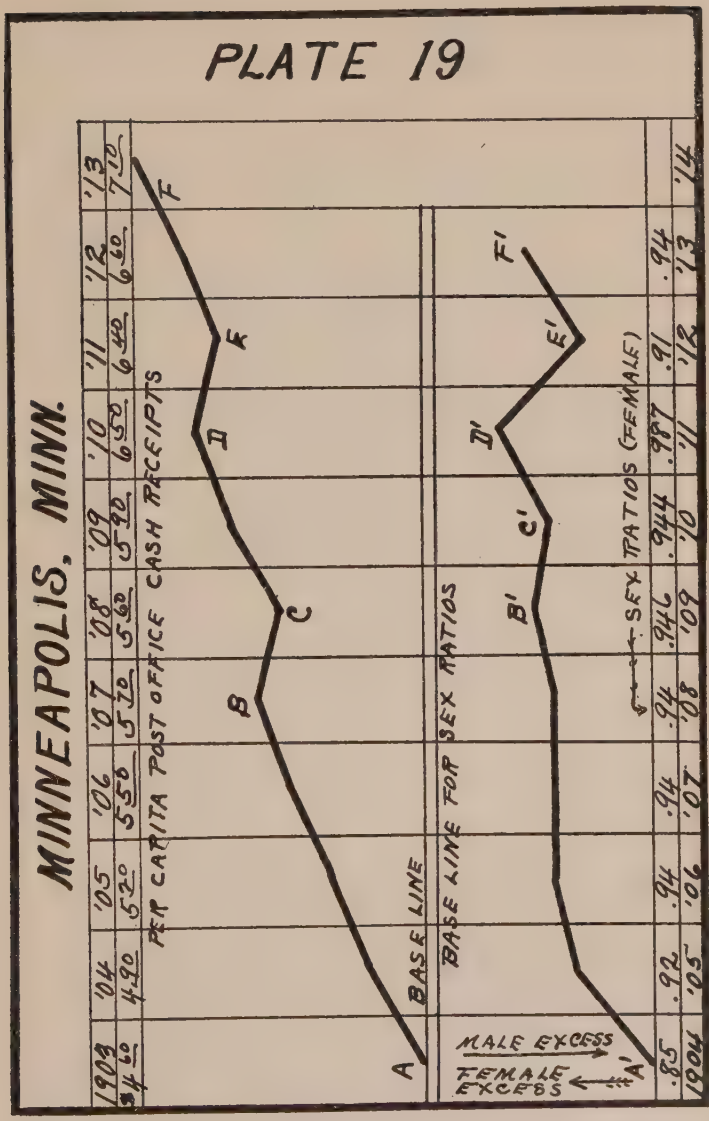


PLATE 19
MINNEAPOLIS. MINN.
1903 '04 '05 '06 '07 '08 '09 '10 '11 '12 '13
$4.40 4.90 5.20 5.50 5.70 5.80 5.90 6.00 6.40 6.60 7.10
PER CAPITA POST OFFICE CASH RECEIPTS
A
B
C
D
E
F
BASE LINE
BASE LINE FOR SEX RATIOS
MALE EXCESS
FEMALE EXCESS
A'
B'
C'
D'
E'
F'
SEX RATIOS (FEMALE)
.85 .92 .94 .94 .94 .946 .944 .947 .91 .94
1904 '05 '06 '07 '08 '08 '10 '11 '12 '13 '14

other's statement upon the subject, affirmed it to be his conviction that a larger volume of moneys went into the post office in hard times than in good times immediately preceding or subsequent. (1)

118. The curve of post office receipts then is a psychological index of the condition of the community and not an economic index. The reactions B′, C′ appear to be lagging, twelve months too slow. It is more than probable that B and C represent peaks actually occurring in November or December of 1907 and 1908, and that B′-C′ are peaks occurring in January or February of 1908 and 1909.

119. Two counties in Minnesota, Clay and Kandiyohi, are found interesting and quite supplemental to the cases of Mercer and Preble counties, Ohio, already noted. PLATE 20 for Clay county gives from top to bottom the rainfall, sex ratio, weather compound, and cloudiness curves. Here female sex production follows the weather compound excepting for the peculiar formation X-Y-Z. Since all three of these points (X-Y-Z) are, nevertheless, at excess female sex production—perhaps we can consider E as one peak. The point Y undoubtedly is favoring some temporary industrial disarrangement rather than any weather variation. Otherwise the weather reaction is very good.

120. PLATE 21 for Clay county gives us exactly similar results even to the slight variation X-Y-Z.

121. A comprehensive glance at PLATE 22 for Kandiyohi county shows that from January to July,

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Note (1) There are several potent considerations, mentioned by the authorities referred to, which warrant the theory of a rise in post office receipts in hard times; first, an increased effort on the part of all creditors to collect moneys due; secondly, a greater number of orders for smaller quantities of goods passing through the mails; thirdly, an increased effort on the part of business concerns to obtain custom; fourthly, the fact that working people, when idle, write more letters than when busy every day.

Note: In plotting an annual rain curve there are frequently months in which less than one inch of rain falls. At such points it is obviously inconsistent to reduce the value of cloudiness by multiplying it by a decimal less than one. Hence, in developing the compound weather curve, as in PLATE 20, I have left the original numerical value of cloudiness intact: e. g. in February, 1903, there was rainfall of 0.7 of an inch. No multiplication is resorted to, and "19.5" in the cloudiness curve is moved to the compound curve as "19.5" without change. However, 2.56 (inches of rain in April) times 15 (cloudy days in April)=38.4, the product entered in the compound curve.

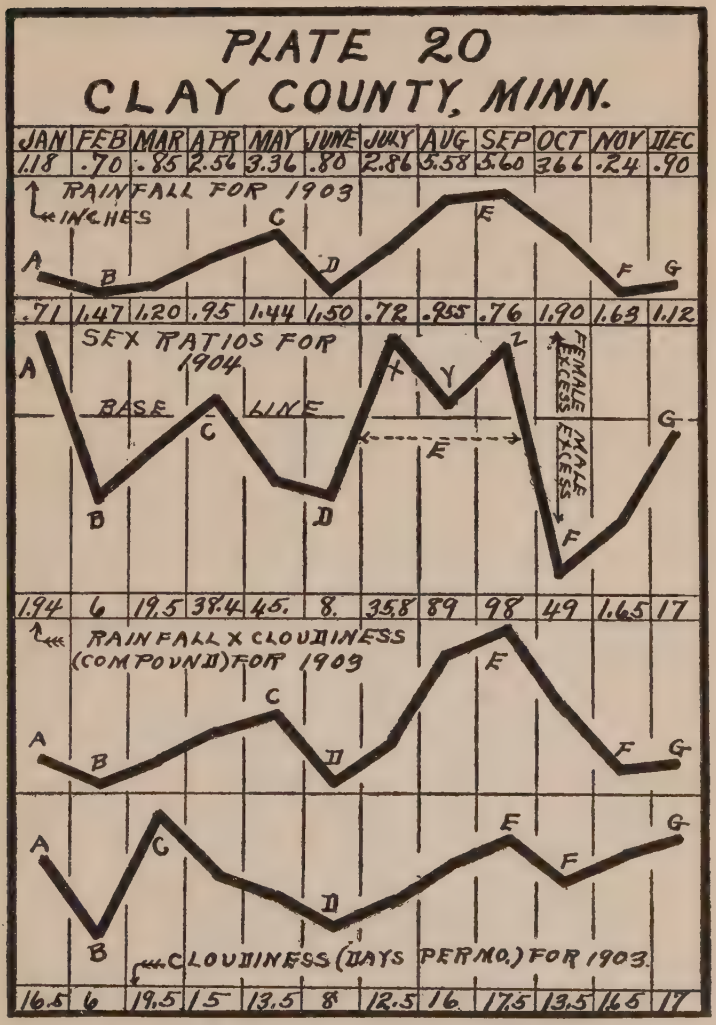


PLATE 20
CLAY COUNTY, MINN.
JAN FEB MAR APR MAY JUNE JULY AUG SEP OCT NOV DEC
1.18 .70 .85 2.56 3.36 .80 2.86 3.58 3.60 3.66 .24 .90
RAINFALL FOR 1903
INCHES
A B C D E F G
.71 1.47 1.20 .95 1.44 1.50 .78 .855 .76 1.90 1.63 1.12
SEX RATIOS FOR 1904
BASE LINE
FEMALE EXCESS
MALES EXCESS
A B C D E F G
1.94 6 19.5 38.4 45. 8. 35.8 89 98 49 1.65 17
RAINFALL X CLOUDINESS (COMPOUND) FOR 1903
A B C D E F G
A B C D E F G
CLOUDINESS (DAYS PER MO.) FOR 1903.
16.5 6 19.5 15 13.5 8 12.5 16 17.5 13.5 16.5 17

Errata:—January column, read 19.4 instead of 1.94.

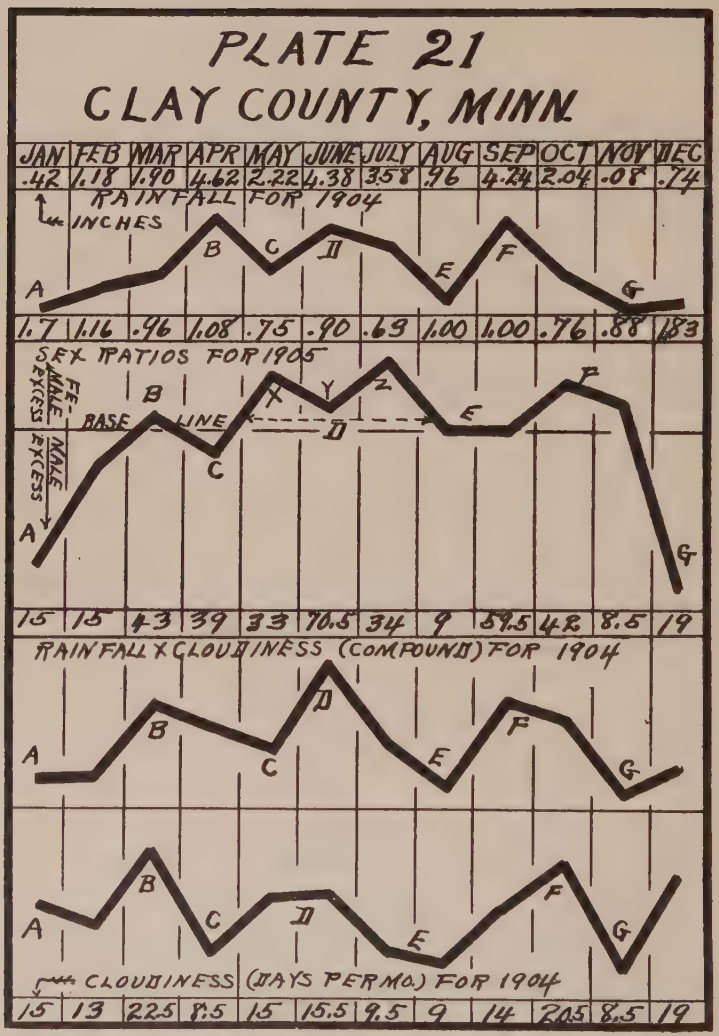


PLATE 21
CLAY COUNTY, MINN.
JAN FEB MAR APR MAY JUNE JULY AUG SEP OCT NOV DEC
.42 1.18 1.90 4.62 2.22 4.38 3.58 .96 4.24 2.04 .08 .74
RAINFALL FOR 1904
INCHES
A B C D E F G
1.7 1.16 .96 1.08 .75 .90 .69 1.00 1.00 .76 .88 1.83
SEX RATIOS FOR 1905
FE-MALE EXCESS
MALE EXCESS
BASE LINE
A B C D E F G X Y Z
15 15 43 39 33 70.5 34 9 59.5 42 8.5 19
RAINFALL X CLOUDINESS (COMPOUND) FOR 1904
A B C D E F G
A B C D E F G
CLOUDINESS (DAYS PER MO.) FOR 1904
15 13 22.5 8.5 15 15.5 9.5 9 14 20.5 8.5 19

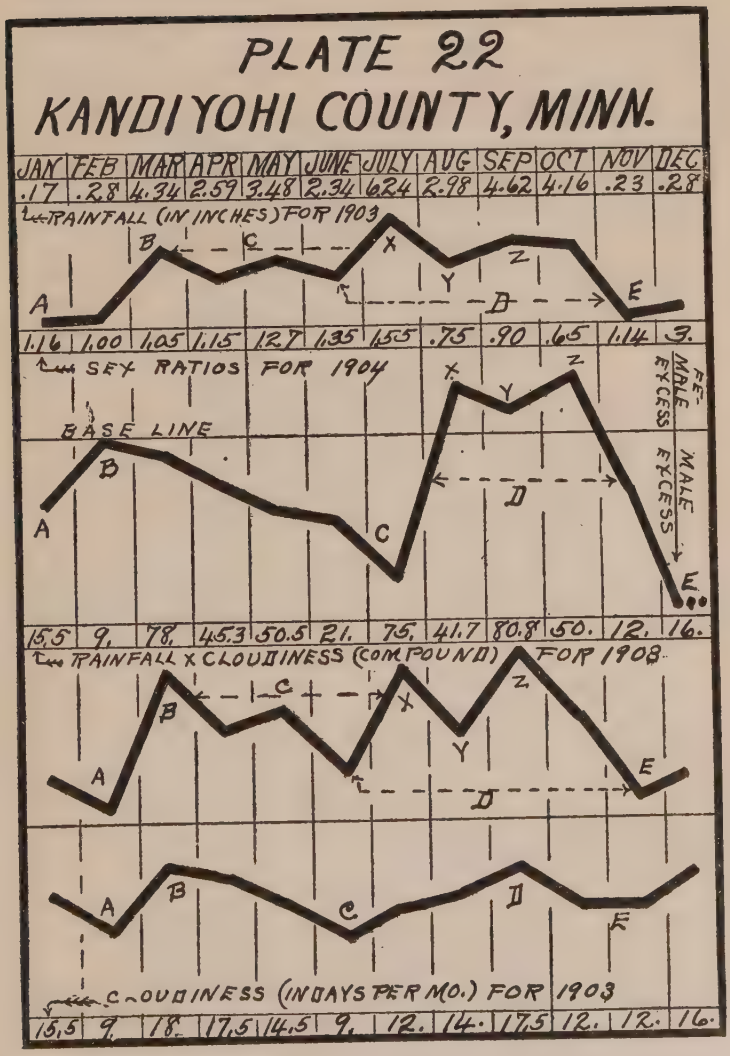


PLATE 22
KANDIYOHI COUNTY, MINN.
JAN FEB MAR APR MAY JUNE JULY AUG SEP OCT NOV DEC
.17 .28 4.34 2.59 3.48 2.34 6.24 2.98 4.62 4.16 .23 .28
RAINFALL (IN INCHES) FOR 1903
A B C X Y Z D E
1.16 1.00 1.05 1.15 1.27 1.35 1.55 .75 .90 .65 1.14 3.
SEX RATIOS FOR 1904
BASE LINE
FF MALE EXCESS
MALE EXCESS
A B C X Y Z D E
15.5 9. 18. 45.3 50.5 21. 75. 41.7 80.8 50. 12. 16.
RAINFALL X CLOUDINESS (COMPOUND) FOR 1908
A B C X Y Z D E
A B C D E
CLOUDINESS (IN DAYS PER MO.) FOR 1903
15.5 9. 18. 17.5 14.5 9. 12. 14. 17.5 12. 12. 16.

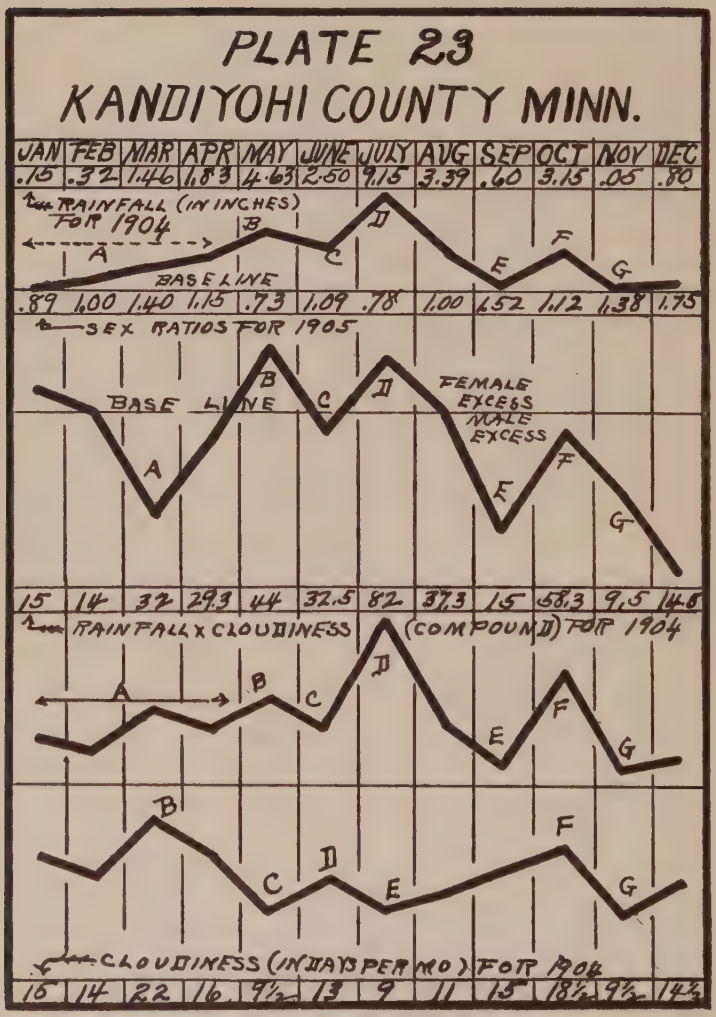
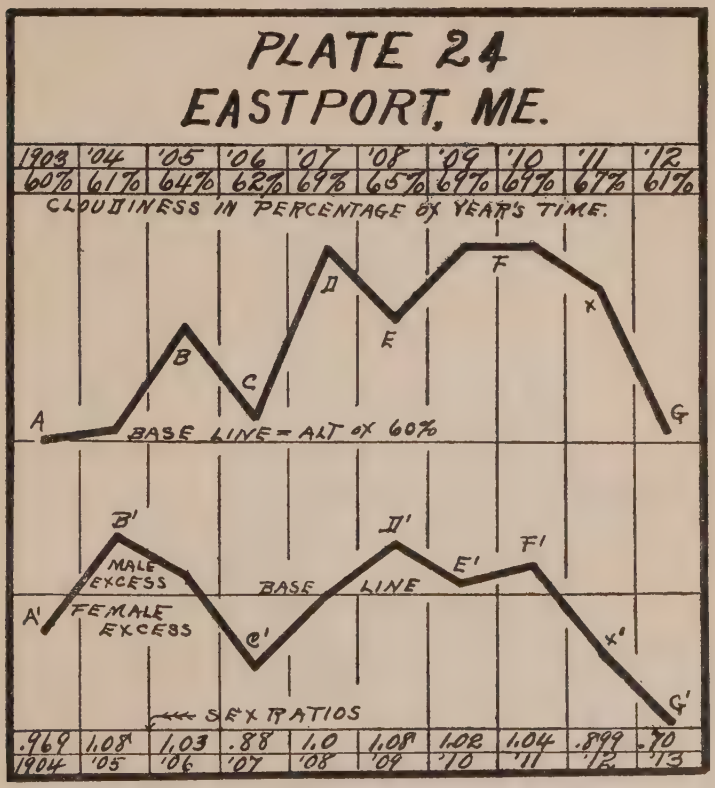


PLATE 23
KANDIYOHI COUNTY MINN.
JAN FEB MAR APR MAY JUNE JULY AUG SEP OCT NOV DEC
.15 .32 1.46 1.83 4.63 2.50 9.15 3.39 .60 3.15 .05 .80
RAINFALL (IN INCHES) FOR 1904
A B C D E F G
BASE LINE
.89 1.00 1.40 1.15 .73 1.09 .78 1.00 .52 1.12 1.38 1.75
SEX RATIOS FOR 1905
BASE LINE
FEMALE EXCESS
MALE EXCESS
A B C D E F G
15 14 32 29.3 44 32.5 82 37.3 15 58.3 9.5 14.6
RAINFALL X CLOUDINESS (COMPOUND) FOR 1904
A B C D E F G
B C D E F G
CLOUDINESS (IN DAYS PER MO.) FOR 1904
15 14 22 16 9½ 13 9 11 15 18½ 9½ 14½

sex ratios favor the cloudiness curve, while from July to December they favor the rainfall and compound factors. Here, exceedingly peculiarly, we find a variation X-Y-Z as for Clay county.

122. From March to November in Kandiyohi county (PLATE 23) female sex production rises and falls with rain in perfect synchronism, and it responds quite well to the weather compound also from April to November.

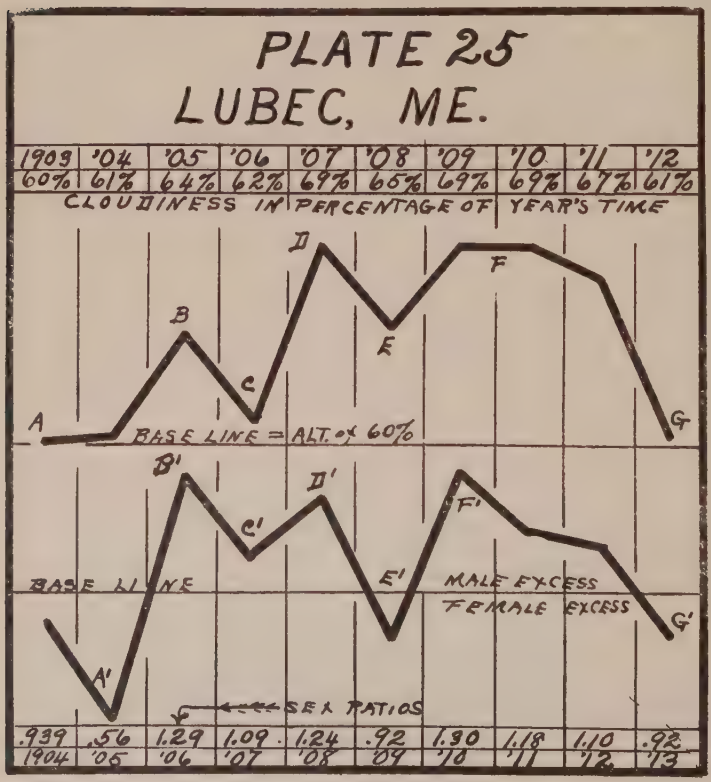
123. PLATE 24 shows ten years of cloudiness, 1903 to 1912, and an equivalent period of sex ratios, 1904 to 1913, for Eastport, Maine. (1) The number of pulsa-



Note (1) Here cloudiness is denoted by the Weather Bureau in percentage; e. g. 1904 was a year cloudy through 61% of its duration.

tions in each curve for the total period is the same, A, B, C, D, E, F, G, in cloudiness and A′, B′, C′, D′, E′, F′, G′, in sex ratios. In this case there is only one reaction accelerated, B-B′. If the monthly figures for 1905 were at hand one would probably find B in cloudiness occurring in January or February of that year and B′ in male births occurring in November or December of the same year. D-D′ and E-E′ appear to be two years in reaction. They are probably only thirteen or fourteen months long; this would produce the appearance of a reaction of two years in a perennial graph such as is given. There is a wonderful similarity in the long droop at the end of each curve, F-X-G and F′-X′-G′.

124. Cloudiness and sex ratios for Lubec, Maine,



are shown on PLATE 25. These are for the same period as those of Eastport. The cloudiness curve for Lubec is identical with that for Eastport as the two localities are but a few miles apart. For Lubec there is perfect synchronism during the ten years with neither lag nor acceleration. From B-B′ onward, each pulsation (e. g., B-C-D) is exactly two years long in each curve except the last, E-F-G and E′-F′-G′ which are four years long! Here again is a heavy droop, F-G, three years long and common to both curves.

125. Why lag and acceleration occur for Eastport and not for Lubec, when both communities are under the same cloudiness conditions, is an obscure question. It is probably due to differences in the detailed characteristics of population or industry of the two places.

126. It is only just to insist that this parallel between cloudiness and sexes in births for Lubec should suffice to silence all further argument against the case for environment and external factors as governing primarily in sex differentiation in human offspring.

CHAPTER V.

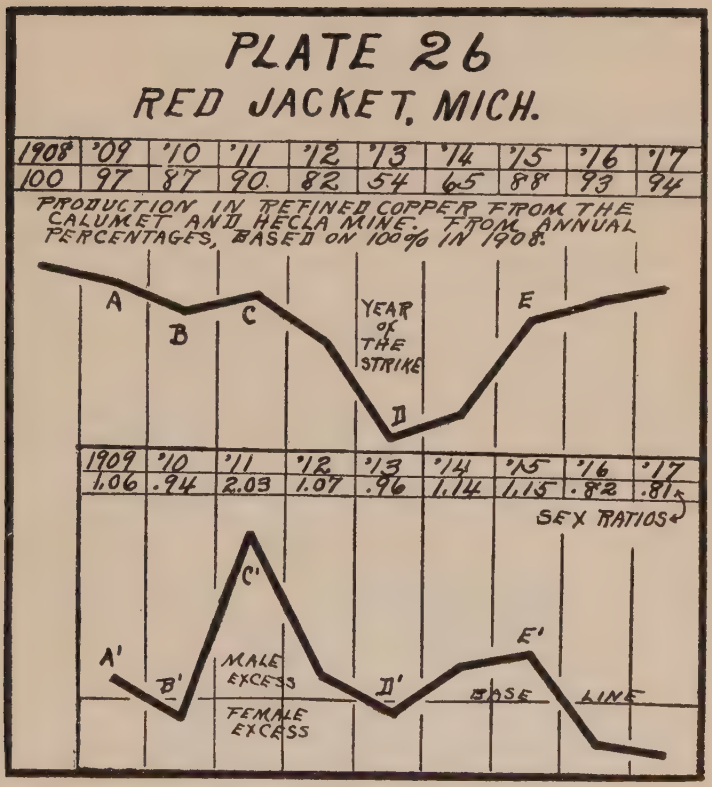
Economic Relativity

127. From considerations already pointed out, one might feel that it would be an easy matter to develop a parallel between the volume of products from any large industry, locally paramount, and the sex ratios in births for that locality, industries being at once, from the new biological viewpoint, either housed or unhoused (i. e., protected or exposed). But I have not been able to offer as much on this point as I had hoped to.

128. PLATE 26 gives for a period of years the percentage in copper production of the Calumet and Hecla Mine at Calumet, Michigan. Here the miners work, day after day, in shafts and tunnels projected for almost a mile below the surface of the earth, where it cannot possibly make any difference in their condition whether there are storm clouds overhead, or whether the blazing sun of midsummer is beating down from a merciless blue sky.

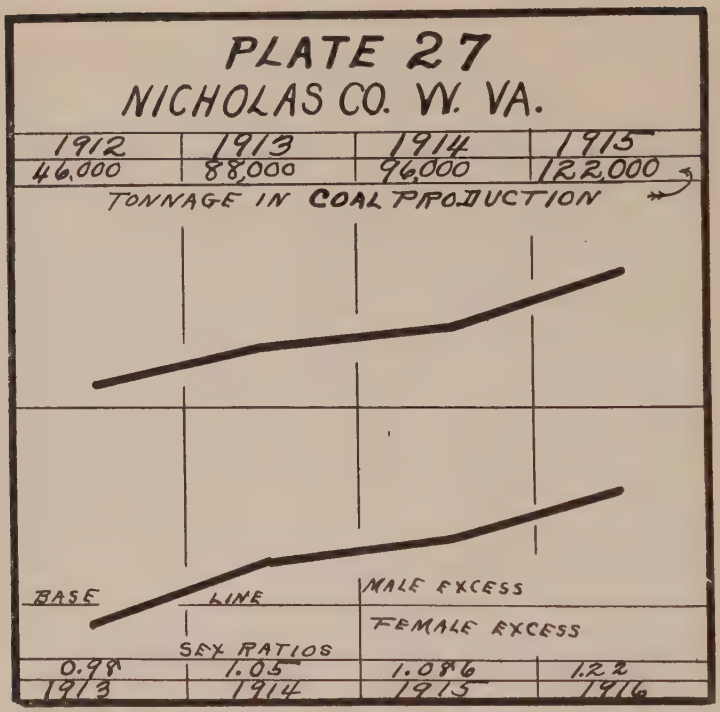
129. Of three towns in this district, Calumet, Laurium, and Red Jacket, the last showed the closest approach with its sex ratio curve to the curve of copper production. High copper production induces, as it seems, an excess production of males in births. When the production of copper drops there is an answer in an increase in the proportion of females, for the reason that the fathers encounter more exposure to sunlight while idle above ground. The parallel runs quite true until 1915, after which it breaks, probably due to shifting personnel of the working force as a result of war time industrial changes. The heavy dip C-D-E, a 46% drop in copper, was occasioned by the great strike at that time.

130. One peculiarity is encountered in this case. The entire sex ratio curve represents a high volume of



male births as occurring during the same year as the corresponding peak in copper. Here is our first encounter with sustained reactions occurring continuously within the year. It points to intense and prolonged industrial confinement for the fathers involved. This view is re-enforced by the fact of the great strike in 1913.

131. Nicholas county, West Virginia, for the only period examined (1912-15 and 1913-16) showed a perfect parallel between coal production and sex ratios in births. This condition is exemplified on PLATE 27. This illustrates well the result of the employment of the fathers underground and away from sunlight.



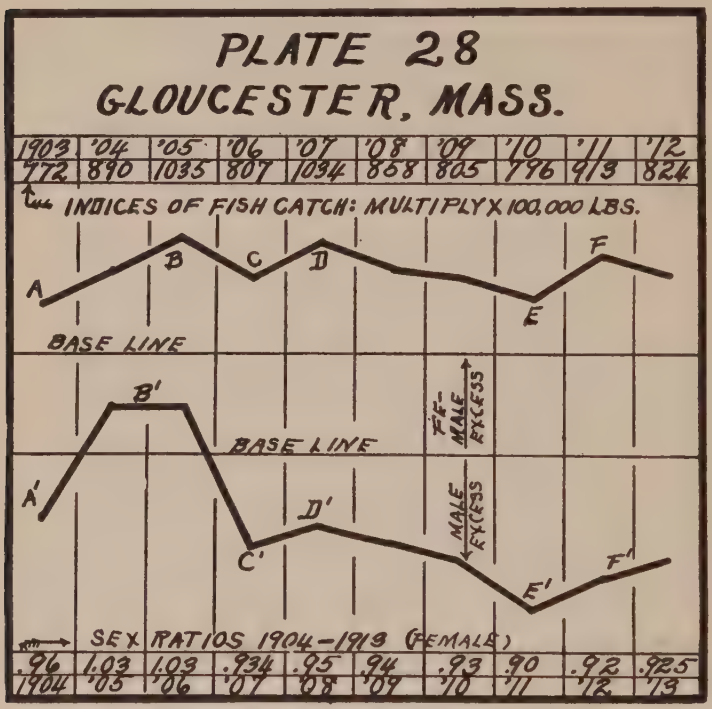
132. However, when taken together with the case of McDowell county in the same state some peculiar problems arise. Nicholas county was only entering the ranks of the coal producing counties in 1914. The production of 46,000 tons in that year shrinks to a mere molehill beside McDowell county's output of upwards of 14,000,000 tons a year at that time. As is shown, a parallel exists for Nicholas county, but McDowell county would not show a parallel for the same period. Why should such a difficulty be encountered in the case of a unit of territory in which probably 95% of the fathers are miners? Why should there be a contrast between these counties? Positive knowledge is not available, but in the case of Nicholas county the coal mining industry is just beginning, and no doubt, for a period of several years prior to 1912, capital had been

busy developing newly acquired coal lands, driving shafts and tunnels, blocking out bodies of coal and doing other extensive underground work preparatory to extraction of the tonnage of 1912. Hence there was in fact much more underground employment than the mere tonnage of 46,000 would indicate. New capital and a new field, and the enthusiasm common to such a case is a combination which betokens the crowding of development and steadiness of employment for such as were connected with the work.

133. On the other hand, notwithstanding the fact that McDowell county was a heavy coal producer, we do not know that there the fathers were employed continuously. Testimony of the coal miners' representatives, given on the occasion of the investigations a few years ago in Washington with regard to the coal strike and financial difficulties in general related to coal production, disclosed as one of their main grievances the fact that the number of hours of labor each week was not sufficient at the rate of pay they were receiving. In other words they were idle too great a portion of the time for a high wage to afford them a living. Nevertheless for the four years 1913-14-15-16, McDowell county produced the unusually high ratio of an average of 21% excess males in births; and nowhere save in manufacturing or mining is there to be found such a high male sex ratio holding steadily, as in this case of McDowell county, for four years.

134. PLATE 28 shows the curve of the fish catch for Gloucester, Massachusetts, for ten years and the curve of sex ratios in complete synchronism for nine years, 1903-04 to 1911-12 without lag or acceleration. In this case is seen a heavy fish catch and its correspondingly increased exposure of fathers out of doors followed by a movement of the births toward females. This result is no doubt aided somewhat by a heavy employment of women in definite housed industries in the city of Gloucester. Particular note should be made of

the reactions, A-B-C, A′-B′-C′, each three years long, and C-D-E, C′-D′-E′, each four years long!



CHAPTER VI.

Further Canvasses and Cases: Interference Factors Come to Light

135. Through much of the summer of 1916, while in Philadelphia, I still felt strongly urged to make a canvass of families, notwithstanding the objections to it which seemed obvious. The question of expediency of method, however, answered itself when I reflected that large numbers of people frequent the public parks on Sundays. I accordingly visited Fairmount Park where the opportunity presented itself for securing data by methods infinitely less formal and less objectionable than those which had earlier been contemplated. Many hundreds of families were out for the day; a large number of them had all their children, concerning whom a casual remark easily opened the channel to inquire more definitely about the parents themselves and their various occupations.

136. By such a method of approach, any possible suspicions or resentment on the part of those from whom I secured data, were forestalled. In only one case did I have cause to suspect deception attempted or even thought of; for that reason alone, that case was rejected. Since all data obtained in every interview are given here it will be seen that I exercised no power of selection related in any way to the compromising of evidence. The only selection in the work in Philadelphia was in an effort, for a time, to pick only families having children of only one sex, first those with boys only, and secondly, those with girls only. Here in the parks was a fair chance to obtain separate lists of considerable volume because the children were on hand as evidence in advance, though, of course, some parents did not have

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The sequence of my researches as originally carried out, is not exactly followed in this volume. What is reviewed in this chapter preceded all curve work on the case, and followed the canvass of teamsters and chauffeurs referred to in Par. 63 and 64.

present all of their children. Because of selection along this one line earlier in the work, there appear in the following lists more unisexual than bisexual cases.

137. These cases, all noted at random and without regard to any preconceived ideas along hypothetical lines, were later reassorted and completely segregated into the classes: "Boys only, Class A," "Girls only, Class B," and "Class C," those with both boys and girls.

CLASS A (Boys only)

Parent	Occupation	Condition or Environment	No. of Boys
Father	Silk worker	Indoors	3
"	Inventor	"	1
"	Machinist	"	2
"	Cigar maker	"	4
"	School teacher	"	11
"	" "	"	2
"	Foreman, clothing mfg.	"	1
"	Laundryman	"	3
"	Tailor	"	1
"	Foreman, paper house	"	3
"	Tailor	"	4
"	Packer in factory	"	2
"	School teacher	"	1
"	Leather worker	"	2
"	Printer	"	9
"	School teacher	"	3
"	Elevator erector	"	3
"	Office clerk	"	2
"	Hatter	"	2
"	Clerk	"	3
"	Machinist	"	2
"	Window cleaner	In and out	2
"	Machinist	Indoors	3
"	Janitor	"	2
"	Coal miner (1)	"	5
"	Auditor	"	3
"	News dealer	"	3
"	Bookkeeper	"	1
"	Baker	"	3
"	Machinist and fireman	"	4
"	Leather worker	"	2

Note: Of all the cases referred to in this chapter, 80% or 85% were taken in Philadelphia, mostly in Fairmount Park, (a few in other smaller parks in that city and a few in the business district), in personal interviews. The remainder of 15% or 20% were taken in 1917-18, partly in Kokomo, Indiana, and partly in Detroit, Michigan.

Note: All cases in lists A and B, which are marked * denote either partial or complete exceptions to the hypothesis which is here being treated.

Note (1) This case of the coal miner with five sons immediately aroused strong suspicions as to the influence of mining in general, which is extensively dealt with elsewhere in this work.

Parent	Occupation	Condition or Environment	No. of Boys
Father	Blacksmith	Indoors	4
"	Tailor	"	1
"	"	"	1
"	Stock keeper	"	1
"	Paper perforator	Always Indoors	2
"	Insurance agent	"	3
"	Tailor	"	1
"	Office man	"	1
"	Chandelier assembler	Largely Indoors	1
"	Machinist	"	2
"	"	"	4
"	Engraver	"	3
"	Rug repairer	"	2
"	Interior decorator	"	2
"	Printer	"	1
"	Machinist	"	3
"	Moulder	"	1
"	Grocery proprietor	"	2
"	Stock clerk	"	3
"	Pattern maker	"	2
"	Bank clerk	"	2
"	Machinist	"	4
"	Plumber	"	1
"	School teacher	"	3
"	Laundry foreman	"	2
"	Blacksmith	"	2
"	"	"	4
"	Leather worker	"	1
"	Chemist	"	5
"	Factory superintendent	"	3
"	Painter	"	2
"	Wood turner	"	4
"	Grocery clerk	"	1
"	Printer	"	1
"	Laundry worker	"	2
"	Bar tender	"	3
"	Stationary foreman	"	3
"	Gas fitter	"	1
"	Model maker	"	2
"	Book binder	"	4
"	Tailor	"	3
"	Shoemaker	"	2
"	School teacher	"	3
"	Paper hanger	"	4
"	Minister	"	1
"	Machinist	"	5
"	Proof reader	"	2
"	Shoe clerk	"	3
"	Power house electrician	"	1
"	Armature winder	"	3
"	Druggist	"	4

Parent	Occupation	Condition or Environment	No. of Boys
Father	Leather worker	Indoors	2
"	Wood turner	"	2
"	Metal enameller	"	2
"	Harness maker	"	5
"	Cooper	"	2
"	Barber	"	1
"	Baker	"	2
"	Machinist	"	3
"	Textile worker	"	5
"	Auditor	"	1
"	Drug clerk	"	3
"	Factory foreman	"	3
"	Janitor	"	2
"	Bank cashier	"	3
"	Proprietor shoe store	"	1
"	Barber	"	2
"	Power house operator	"	4
"	Stationary engineer	"	2
"	Foreman hat factory	"	3
"	Photographer	"	2
"	Saloon keeper	"	2
"	Brass moulder	"	1
"	Factory foreman	"	3
"	Dry goods clerk	"	4
"	Cafe waiter	"	1
"	Boiler maker	"	2
"	Broker (office)	"	1
"	Machinist	"	1
"	Optician	"	1
"	Receiving clerk	"	3
"	Tailor	"	1
"	Chain maker	"	2
"	Cigar maker	"	5
"	Tinner	*Largely Indoors	2
"	Draftsman	"	2

Total, 117 cases

138. We shall next consider, in Class "B", those families having girls only. In the majority of all families the mother's general life habit and sphere of action is largely within doors. Thus she is subject to a fixed condition of protection, and under the hypothesis we are contemplating, she has the advantage of a correspondingly high sex potential; this much is self evident. Therefore, in Class B we still seek to find the prime determinant in the majority of cases by ascertaining the variations or constancy in the occupation of the father; but in some cases in which the mother herself has or

has had some recent definite occupation, or in which she is subject to some special condition which thrusts upon her an unusual degree of protection, that occupation or condition is cited as apparently governing.

CLASS B (Girls only)

Parent	Occupation	Condition or Environment	No. of Girls
Mother	School teacher	Indoors	3
Father	Greenhouse proprietor	Exposed	1
"	House painter	Outdoors	2
"	Slate roofer	Outdoors	2
"	Grocery deliveryman	"	2
"	Railroad fireman	"	2
"	Painter	"	4
"	Landscape gardener	"	3
"	Railroad engineer	"	1
"	Street sweeper	"	1
"	Travelling salesman	Largely Outdoors	2
"	Roofer	"	2
"	Railroad track inspector	"	3
"	Mail carrier	Largely Outdoors	2
"	Installment collector	"	2
"	Street car motorman	Largely Exposed	1
"	Park guard	Outdoors	4
"	Mate on steamboat	Largely Outdoors	2
"	Grocery deliveryman	"	3
"	House painter	"	3
"	Railroad brakeman	"	1
"	Insurance collector	"	2
"	Mail carrier	Largely Outdoors	5
"	Roofer	"	3
"	Peanut vendor	"	1
"	Chauffeur	Largely Outdoors	2
Mother	Waitress	Indoors	2
Father	Travelling salesman	Outdoors	2
"	Professional ball player	"	3
"	Sign painter	Largely Outdoors	4
"	Printer	*Indoors	1
"	Painter	Outdoors	1
"	Textile worker	*Indoors	1
Mother	Milliner	"	3
Father	Steam shovel engineer	Outdoors	1
"	Core maker (foundry)	*Indoors	1
"	Outside painter	Outdoors	2
"	Book binder	*Indoors	1
"	Builder and contractor	Largely Outdoors	2
"	Tailor	*Indoors	2
"	House painter	Outdoors	4
Mother	School teacher	Indoors	3

Total, 42 cases

139. In Class B there are forty-two cases, of which thirty-three indicate a very large or complete factor of exposure for the father out of doors. In four cases the mother's occupation is pointed out, i. e., one milliner, one waitress, and two school teachers. Five cases for fathers are indexed as exceptional. One of these, that of a textile worker, developed the fact that his mate was a woman of very feeble health, very seldom leaving the house. Such a condition on the part of a mother as will be noted further in the analysis of special cases, is extremely conducive to the production of daughters. Dr. Romme of London, as mentioned in Par. 14, was the first to point out and emphasize, quite a number of years ago, his conviction that the less vigorous parent transmitted, preferably, his or her own sex to the offspring. This phenomenon is a fact for the human species for a substantial majority in any considerable group of typical cases which may be examined. There have been only three separate facts set forth up to the present time which bear especially upon the case for the human species, and this is one of those three facts. Not one of the facts has been very vigorously defended, and there has been a constant effort at deriding instead of examining them.

140. It will be worth while to refer to a peculiar state of affairs which developed during the canvass for the cases in Class B. There are only about half as many of these cases as those in the list of "boys only." During the canvass in Fairmount Park there seemed to be present an ample quota of families with girls only, but I gradually became aware of the fact that in a great majority of cases, the mother alone served as the escort of the brood. I was constrained to forego my interrogatory a number of times for this reason. But it will be seen that this basis for a partial canvass did not operate to bias the results. Thus far I have construed this phenomenon as indicating that the fathers of such feminine families were normally of outdoor occupations, and that upon the occasion of a rest day, they were only too glad to remain in the shelter of their homes regard-

less of the disposition of the remainder of the family to take to the open.

141. The third division is composed of cases in which the children were both boys and girls.

CLASS C (boys and girls)

Parent	Occupation	Condition or Environment	No. of Boys	Girls
Father	Blacksmith (1)	Indoors	2	6
"	"	"	5	2
"	Grocer (2)	"	2	6
"	City fireman (Largely)	"	8	6
"	Plasterer and fireman	"	3	2
"	Pipe fitter	"	1	2
"	Restaurant proprietor	"	2	1
"	Barber	"	3	1
"	Official at city workhouse (3)	"	5	1
"	Moulder in foundry	"	2	3
"	Machinist	"	2	2
"	"	"	3	1
"	Coal miner	"	5	2
"	Weaver	"	1	5
"	Cafe steward	"	1	1
"	Salesman	"	1	1
"	Carpenter (Largely)	"	2	1
"	Barber	"	2	1
"	Shoemaker	"	2	2
"	"	"	2	3
"	City fireman	"	2	1
"	" "	"	1	1
"	Garment worker	"	1	1
"	Tailor	"	3	3
"	Millwright	"	2	2
"	Grocery proprietor	"	3	1
"	Cloth cutter	"	3	4
"	Tobacco salesman (office)	"	2	1
"	School teacher	"	7	2
"	Shipping clerk	"	1	1
"	Insurance agent (Partly)	"	2	2
"	Chauffeur (Largely)	Outdoors	1	1
"	Clerk	Indoors	1	2
"	House painter (Partly)	Outdoors	1	3
"	Tailor	Indoors	1	1
"	Boilermaker	"	1	4
"	Trainman (Largely)	Outdoors	3	1
"	Druggist	Indoors	2	3

Note (1) The mother of these children, deaf to her husband's protests, literally worked herself to death in the home, often sewing until one or two o'clock in the morning, and never going out for recreation.

Note (2) The mother in this case lived a very secluded life.

Note (3) The father was for years an official on the detective force.

Parent	Occupation	Condition or Environment	No. of Boys	No. of Girls
Father	Proprietor tailoring business	Indoors	3	3
"	Clothing merchant	"	1	1
"	Paper hanger	"	1	2
"	Boat captain (1)	Outdoors	1	3
"	Shoemaker	Indoors	2	2
"	Clothing merchant	"	1	1
"	" "	"	1	1
"	Bartender	"	2	5
"	City fireman	"	2	2

Total, 47 cases

142. In all of these cases both boys and girls had been born, and in 44 cases out of the total, there is indicated for the fathers ordinarily complete protection indoors in their occupations. There are only three of the cases in which the father's exposure out of doors is complete or nearly so. However, such a contrast is perhaps prematurely drawn, for out of the total of 247 cases in the canvass beginning in August, 1916, the foregoing lists comprise but 206 cases.

143. The remaining 41 cases will be reviewed seriatim. Aside from many points of deep interest, they will disclose the nature of some important factors which relate immediately to the question of how quickly or how slowly certain individuals react in sex potential from the influence of the motive power, sunlight.

144. CASE 1. The canvass of these cases had been under way but a short time when I realized that now and then a case would arise which was an absolute exception to the general proposition of "indoor protection against outdoor exposure." Not many such had come to my attention before I met a father in the park with his four sons, enjoying the benefits of the time and place. He was a street car conductor, of Irish extraction, weighing about 180 pounds. He was very freckled; and both his hair and face might well be termed a flaming red. He was a powerfully built specimen; of a genial disposition and ready to talk about his boys. The four with him had red hair and he informed me

Note (1) Wife constantly ailing.

that he had three more sons at home, but no daughters!

145. Surely here was potential sufficient to stop my attack upon the problem and compel either an abandonment of the sunshine hypothesis or a close watch for some important modification of it; for, beyond question, this man's work on the street cars for seventeen years had subjected him to a large measure of exposure without apparently affecting his sex potential at all. His own complexion, to say nothing of its transmission to all of his sons who were present was a most striking and prominent characteristic. From that time on I watched constantly to discover if complexion really had any bearing on the case; for it still seemed that, including the first canvass of teamsters and chauffeurs, too much favorable evidence had accumulated in support of the hypothesis to warrant rejecting it solely on the strength of one case, however disconcerting that one might be.

146. The case of the Irishman was as interesting as it was exceptional, and I continued the making of notes on complexion. "Skin color" or complexion is what might be called the "physico-reciprocal" of light. From this premise it is but a step in reasoning until we see the inevitability that certain complexions, some no doubt more than others, offer a definite resistance to the action of sunlight upon the germ cell. Complexion, therefore, stands analogous to a "screen" in the human system to shield the sex economy from the action of sunlight; henceforward, any condition or factor which acts in such a capacity will be designated as a "screen."

147. Complexion may be termed the "chromo-epidermal" screen, and in the exceedingly ruddy complexion of the Irishman lay the secret of his ability to transmit his own sex to all his offspring despite his long period of comparative exposure in the street railway service. Thus we are brought at once to face a complicated state of affairs which would seem endless when we take into consideration the multitude of different complexions and

intermediate types in humanity. The problem assumes more and more an increasing similarity to the picking of a combination lock.

148. It was a year and a half after first conceiving that complexion bears this relation to the problem, and then not without carefully weighing a considerable number of cases, that I constructed a chart suggesting the relative positions of various complexions in their resistance to sunlight. In this chart, (PLATE 29), those complexions and combinations thereof which seem to be the weakest are placed at the top. Reading downwards one approaches those which offer the greatest resistance, and which, consequently, afford the greatest protection for the sex economy. The left-hand column contains those types of which the relative positions in the scale seem assured beyond all reasonable doubt; in the right-hand column are a number of odd, mixed or infrequent types, the positions of which are only approximate. An explanation as to just how complexion operates to cause such effects cannot now be given. It is to be noted that the darker pigments of brunettes offer less resistance in this capacity than do the lighter pigments of blonds.

149. Exemplifying briefly the force of this chart, it may be asserted that if a person with black hair and black eyes be exposed constantly to sunlight, the ability to transmit his or her own sex to offspring will break down far sooner than would be the case for a person with red hair and blue eyes, similarly exposed. A number of cases have come to my attention, beside the one just discussed, which make it a matter of serious doubt that the sex potential of very auburn types can be affected at all by sunlight.

150. There are four standard types designated "*", from which probably the majority of other types and combinations have been derived. And, ranged between black hair and black eyes, the weakest in the scale, and red hair and blue eyes, the strongest in the scale, are practically all other types, both certain and uncertain.

PLATE 29

THE CHROMO-POTENTIAL SCALE

Showing the Relative Positions of Various Combinations in Complexions in the Graded Scale of their Resistance to Sunlight.

REGULAR, CERTAIN & FREQUENT TYPES	IRREGULAR, UNCERTAIN OR INFREQUENT TYPES
WEAKEST	
*Black hair and black eyes.	
Black hair and brown eyes.	Brown hair and black eyes.
*Brown hair and brown eyes.	Blond hair and black eyes.
Medium blond hair and brown eyes.	
Medium blond hair and blue eyes.	Black, brown, or blond hair in combination with grey, hazel, or blue-brown eyes.†
*Light blond hair and blue eyes.	
Reddish brown hair and blue eyes.	
Light red hair and blue eyes.	Light blond hair and brown eyes.
*Intense red hair and blue eyes.	Red hair and black eyes.
STRONGEST	
(*Indicating probably standard or basic types.)	(Note †—the blue-brown eye is practically green.)

For eye color alone grey is probably the strongest, but it frequently occurs with dark and weak colors in hair. Beyond question freckles indicate a high capacity of the Sex-Potential, but their relative value is not certain.

151. From this now arises the more general proposition that all humanity is divided into polychromatic races and nations, and monochromatic races and nations. Chief of the polychromatic peoples are Anglo Saxon, Teutonic, Scandinavian, Gaelic, Celtic, Slavic, and so on. It is for such that the table is constructed. American aborigines, Hindus, Japanese, Chinese, Negroes, etc., are monochromatic. It follows from this chart that the indicated strength of blond hair is seriously reduced by being combined with black eyes in the same individual, and blue eyes offset a great deficiency in the strength of brown hair when combined with it. The sex potential capacity indicated by blue eyes greatly offsets the weakness implied by dark hair, and eye color is pointed to as of more importance than any hair color short of auburn.

152. It should be understood that the color of hair and eyes does not at all indicate what the momentary value of the sex potential is. It indicates only how comparatively high or low the sex potential may go under the essential conditions. Thus the sex potential of a brown-eyed person who has been sheltered from sunlight for a long time may be higher at the moment of comparison than that of a blue-eyed person who has been engaged in outdoor pursuits for an equal period.

153. Kinkiness of the hair, color for color, and freckles also seem to show a still higher capacity of the sex potential. Types such as these as well as those with auburn hair and with gray eyes have, so far, been excluded from all my work along practical lines. (1)

154. I have made a number of statements relative to the subject of complexion which are not absolute, as

Note (1) I early concluded that the sex potential indicated by gray eyes is suspiciously high. It seems a remarkable coincidence, if not altogether related to the discussion, that in 1918, the United States War Department reported from an eight months sharpshooting test at Camp Bowie, Texas, that proficiency in shooting is immediately related to eye color and the scale thus developed follows:

WEAK Black eyes.
Brown eyes.
Hazel brown eyes.
Blue eyes.
Blue gray eyes.
STRONG Gray eyes.

the reader may have supposed. They now become subject to or combined with another factor of primary bearing. The force with which complexion impressed itself upon the problem induced me to watch for the possibility of other serious "interferences," and the suspicion arose that in all probability, weight—literally the physical size of the individual—had a great deal to do with the question of how easily the influence of sunlight might reach and affect the gamete. It appeared almost axiomatic that it would be much more difficult for sunlight to react upon the germ through the superfluous flesh of a heavy person than through the frame of one of lighter weight.

155. Observations on this point tended frequently to strengthen the conviction until finally "weight" was admitted as the second conditioning factor and it may well be termed the "corporeal" screen. However, weight is not secondary to complexion in importance; the two are fully coordinate. While I previously stated that the sex potential capacity of auburn types was very high, and not yet accurately gauged, some instances came to light which seemed to indicate that a balance in sex potentials could be approximated if a brunette exceeded by 45 to 60 pounds the weight of his or her auburn mate, assuming equal conditions of exposure for both. In other words excess weight will serve in lieu of a weak complexion to shield and build up the sex potential.

156. Guided by a life insurance chart showing standard weights of both men and women of all ages, I arbitrarily selected a man of thirty-five years, five feet six inches tall, and a woman of thirty years, five feet five inches tall as being fairly representative of the highest available average in vigor and reproductive capacities. By this chart the man weighs 146 and the woman 134 pounds. By dividing the former figure by the latter, (146/134),) the result is 1.07 in favor of the male. It was noted before that the standard in favor of the male sex in birth ratios for the United States is 1.053. The excess exposure of the male sex out of doors

favors a reduction in values as is seen here, 1.07 to 1.053. This alone is strong circumstantial evidence to warrant the adoption of weight as a vital factor in the problem.

157. There follows a consideration of the remainder of this group of cases, which were originally part of those segregated into Classes A, B, and C: (1)

158. CASE 2. The father was a shoemaker at the bench for thirty years. He thus benefitted by a long period of protection indoors practically on a par with that of his wife, a stout woman, who remained closely at home most of the time. Births occurred to the couple in the following order:

3 Boys in succession
1 Girl
3 Boys in succession
1 Girl
1 Boy
1 Girl
1 Boy

The regular alternation of sexes in these births indicated that the mother's health had always been excellent and the father informed me that such had been the case.

159. CASE 3. The father began as a worker in a foundry where indoor protection was the equivalent of that of his mate in her home. During the time he was so engaged there were born

1 Girl
1 Boy
1 Girl

After this the father changed to the exposed occupation of locomotive engineer and there were born next

2 Girls

Throughout the period of these births the mother's health and activities remained normal.

Note (1) This chapter closes with a discussion of special cases but it has been necessary to deal in advance with principles which those cases first developed in order to render easier the comprehension of them.

160. CASE 4. The father was engaged continuously in transfer and teaming work, thus being given a maximum of constant exposure out of doors. His weight averaged 150 pounds, but it gave him no relief from his handicap of black hair and very dark eyes, as contrasted to a very frail mate of 100 pounds who had brown hair and blue eyes, and who constantly verged on invalidism.

4 Girls in succession
and 1 Boy

were born in this case, the boy dying within seven days of his birth. The girls were all strong and healthy regardless of their mother's infirmities. It is my contention that the one boy was conceived under conditions which threw him too close to the line at which sex differentiates, and it resulted in an early death. He came too nearly being a fifth daughter and he perished from what we now interpret as sex stresses thrust into his system. This conclusion is not premature. I noted a number of such.

161. CASE 5. This is another example. Mr. A. B., of Dearborn, Michigan, was a locomotive engineer when twins, a boy and a girl, were born. The boy died within a very brief space of time and the girl survived only after a severe struggle, apparently of a nervous origin. This case is startlingly clear. The boy came too nearly being a girl; he perished from sex stresses. And the girl came almost as nearly being a boy.

162. CASE 6. The father was a fireman and pump tender at a city pumping station near Fairmount Park, (Philadelphia). The mother lived an exceedingly secluded existence; she was never known to take her children out, even to the park which was only two or three blocks distant. There were born

2 Boys in succession
1 Girl
1 Boy
5 Girls in succession

It is readily seen here, how, earlier in life, the mother,

through fewer responsibilities and a greater margin of activities and exposure, responded with more nearly regular alternations in sexes of the births. Later in life as her duties increased and her domestic seclusion became more pronounced, it finally culminated in the production of five girls. Could one wish for anything plainer than this to indicate the action of some extraneous influence, which varies from year to year, in controlling sex? It indecisively oscillates from one to the other and finally falls over entirely in the mother's favor. When we can find about us everywhere cases which show just such characteristics as this, are we sure, after all, that the issue of sex "is due to fixed and unalterable characters inherent in the germ cell"?

163. CASE 7. The case of Mr. Z., who at the time of this record was in the employ of the Detroit, Michiga, Board of Education, at one of the public schools: He was originally a farmer in the province of Ontario, Canada, where his first three children, two boys and one girl, were born. After coming to the city of Detroit he drove a bakery wagon for a period of years during which two more daughters were added to his family, the result of his long exposure out of doors. He finally took up janitor work which gave him indoor protection for ten years (up to 1919). During this period two more sons were born.

164. CASE 8. The father was a painter employed at outside work almost exclusively through all the years of family rearing. He weighed about 150 pounds, which was not excessive, and had black hair and black eyes. His wife was a blond (light hair and blue eyes), who weighed about 130 pounds. Here was a splendid balance in weights and complexions, but utterly ruined by the great disparity in exposure factors for the pair.

4 Girls in succession
1 Boy
1 Girl

in the order of their births, constituted the family. At the time of noting this case, the boy was seven years

old. He was born in 1909, subsequent to the panic of 1907. The father stated that in 1907 and 1908 he had been idle to a considerable extent; this was the first idleness he had ever experienced during the entire period of the family history. During that period he undoubtedly enjoyed more shelter indoors, at home or elsewhere, than at any other time. The one son was the logical issue of such conditions. This case would seem quite eloquent indeed.

165. CASE 9. This is an instance in which opposing conditions compensate beautifully. The father was a farmer; he had black hair and weighed 140 pounds. His wife was a blond of an exceedingly active disposition. She weighed only 98 pounds. Beginning life on the farm, the father's weight compensated for his weak complexion and exceptional exposure. The mother's complexion compensated for her light weight and for her unusual outdoor activities; an almost even balance produced

1 Boy
1 Girl
1 Boy
1 Girl.

As a farmer, the father finally proved to be a failure. He began to use liquor heavily; and through idleness in saloons and other places which afforded plenty of shelter

2 Boys in succession were born.

166. CASE 10. The father first worked in a canning factory, a sheltered occupation. One girl was born. Following this, he continued work indoors for several years as a button cutter and as an employee in a machine shop. During these later years there were born in succession

5 Boys!

He then took up work on a farm and there followed in births

3 Girls.

In this case the first child may have been born too soon for its sex to be related to the father's post-nuptial

occupation. No data could be obtained as to this feature nor as to the mother's weight and complexion.

167. CASE 11. A New Jersey farmer. The issue from his first marriage were seven girls in succession. Following the death of his wife it is more than probable that his life habits changed to a large degree; several considerations, not the least of which was an increase in care necessary for his motherless brood, would involve more shelter indoors for him. Perhaps also, courtship incidental to his second marriage would lessen his normal margin of exposure on the farm. To the second union were born

1 Son
and 7 more Daughters in succession!

The one son was from birth a weakling; he died at seven years of age. There were no indications of definite disease, hereditary or otherwise. This is another case in which the circumstances strongly indicate the combat of sex stresses from which the child could not escape. The record of this New Jersey farmer is truly remarkable, and when we view it in its entirety, we are very far from agreement with Professor Morgan's proposition in his "Experimental Zoology", (1) for in this case is found a father with a sex potential opportunely sufficient to produce one weak son, but whose whole existence otherwise was under the influence of an extraneous force, inducing preferably the production of daughters. It requires no exercise of the imaginative powers to observe here the temporary strains or stresses acting and reacting as plainly as if plotted on paper. (2)

168. CASE 12. The father was a machinist. During this time one boy was born. The birth was in entire agreement with the father's occupation. Later, the mother's health failed; and thereafter she verged continuously on invalidism. This confined her more closely to her home so that she received the benefit of a larger

Note (1) Vide Par. 1 (this volume.)
Note (2) This case of the New Jersey farmer, together with that of the coal miner with five sons, noted in Par. 137, and that of the fireman and pump tender in Par. 162, were described by one man who took a very keen and intelligent interest in the subject.

degree of protection than did the father at his work. After the health of the mother failed, two girls in succession were born.

169. CASE 13. The father was a chauffeur. One boy was born to the couple. The father's occupation gave him a heavy margin of exposure out of doors, but he was of a sandy complexion, (near auburn), a man of excessive vitality and of a very rugged build. It seems probable here that his heavy frame and his complexion served to counterbalance the exposure arising from his occupation. No information was secured relative to the mother.

170. CASE 14. The father, for a period of seventeen years, worked at cutting timber in the woods. This occupation is normally one of exposure to sunlight, the degree of which, however, is modified at times by meteorological conditions, and by the amount of foliage above; the latter in turn varying with the nature of the trees, the seasons, and with the density of the forest. Questions in detail about the man's mate brought out the facf that she was very active, working outdoors a great deal with garden, flowers, and chickens; she thus subjected herself to a great degree of exposure. It would seem, therefore, that for a long time conditions for this pair were substantially balanced, and there were born

1 Girl
1 Boy
1 Girl
1 Boy.

By this time the health of the mother broke and during the remainder of the first period of seventeen years there were born three girls. The father then for the first time in his life entered indoor work in a stove factory in Kokomo, Indiana; after he commenced work in this plant in which conditions of shelter were complete, two boys were born. While no data were recorded in this case as to weights or complexions of the parents, the sex in the births followed the variations in health con-

ditions and occupational activities so absolutely unerringly as to render wholly superfluous all other considerations.

171. CASE 15. The father was of very dark complexion; he weighed from 175 to 190 pounds. The mother always weighed about 135 pounds and was practically a blond. The family life began on the farm but the father was unsuccessful at this. He took up business pursuits. There followed in births,

4 Boys in succession
1 Girl
1 Boy
1 Girl
1 Boy.

We have no exact occupational data as a basis for the segregation of these births, but the case is valuable as an example in weights and complexions. The father's excessive weight overcame his handicap in a weak complexion. Furthermore, the fact that he was not successful as a farmer appears to indicate that he was not very fond of the occupation and his dark complexion corroborates this view. It is probable too that prior to marriage the mother had followed outdoor habits extensively, responding to the urge of her complexion. At any rate, the first four boys were born in response to the father's excess weight. When the family had grown to this size household duties were making increased demands upon the mother, resulting in her further seclusion within doors. To this is added the original advantage of her light complexion and daughters finally became a possibility for her.

172. CASE 16. In this case the father was a farmer. He and his wife were of about the same weight and both were in excellent health. The wife was very active; her work about the farm rivalled that of her husband. Without data as to complexions but with weights and exposure for the two being about equal, one sees a convincing regularity of alternations in the sex of their offspring:

1 Girl
1 Boy
1 Boy
1 Girl
1 Boy
1 Girl
1 Boy.

173. CASE 17. The father was of medium light complexion and weighed about 160 pounds. At the time of marriage he was employed in office work. A little later he entered a manufacturing business of his own. During this period of indoor protection there were born in succession, three boys. He then began travelling as a salesman. For years he did the hardest work of his life, informing me that he was out in all kinds of weather and on the move constantly. During this occupation under exposure five girls were born. Once more he took up duties which gave him a great deal of shelter indoors. There followed two more boys! In the contemplation of such sharply defined and pertinent phenomena as this in the realm of sex we cannot give ear to the discouraging pronouncement that "it is futile to seek for cause in environment."

174. CASE 18. Here the father was a successful farmer. He weighed 175 pounds, had black hair and blue eyes and was always in good health. His mate weighed 100 pounds, had black hair and gray eyes. She was always very active while in normal health, caring for garden and chickens, and always visiting and ministering in many ways when misfortune invaded a neighbor's home. The issue were

1 Girl
and 3 Boys in succession,

after which the mother's health failed. There were subsequently born

3 Girls.

175. CASE 19. The father was engaged in the tailoring business. He weighed 140 pounds and had

black hair and dark grey eyes. The mother weighed 125 pounds and had brown eyes. She was in good health and gave careful attention to household duties. Three boys and three girls were born; the order of births was not ascertained. However, in this case it certainly appears that a very even balancing of all three factors resulted in an even distribution of sex in the offspring.

176. CASE 20. This case is quite similar to that preceding. The father was engaged in the clothing business. He was of light complexion and weighed 138 pounds. The mother was a brunette weighing 165 pounds. To this union

1 Girl
1 Boy

were born. Here the father's complexion and his protected occupation offset his light weight, while the mother's weight counterbalances her weakness in complexion and probable exposure in excess of the father's.

177. CASE 21. The father was a young man of dark complexion weighing 200 pounds. He was a clothing store proprietor. The mother was a blond weighing 130 pounds. There were born

1 Girl
1 Boy.

Here again is a balancing of all three factors for each parent and an even distribution of child sex.

178. CASE 22. The father, a brother of the man in case 21, was a clothing merchant. He was a blond weighing 170 pounds. His wife was a brunette weighing 115 pounds. The issue was one son. Here two factors for the father are in the ascendant, and the third, indoor protection may also favor him somewhat in excess of his wife. The result is inevitable.

179. CASE 23. The father was a carpenter. Both he and his wife were blond, with blue eyes almost identical and both weighed about 138 pounds. The father was an active worker and the mother spent

much time out of doors as well. Here is a complete balance of all factors, such as could rarely be expected in a practical case. From this union issued two boys and two girls.

180. CASE 24. The father was engaged in the real estate business and was out of doors much of the time following his marriage. He was an intermediate "blond brunette", weighing 145 pounds. His wife was a brunette who weighed 115 pounds. There was born to them first one girl. The father then left this pursuit and assumed his former occupation of an artist and interior decorator. There were born in succession, 3 boys.

181. CASE 25. The father, (1) an Irishman, was typical of his race. He had a very ruddy face and shaggy sandy hair. He weighed 165 pounds and in fact was a close parallel to the first of these special cases, described in Par. 144. His wife was a brunette (weak complexion). He worked originally in the sugar beet industry, alternating in field and factory. During this time four boys in succession were born. Upon previously established lines the analysis of this case is obvious. If only the mother's weight had equalled that of the father, then, in view of the high margin of exposure in the beet fields, the probabilities are that he would have had to share honors with her in the sex of the children. This would likewise have been the result if she could have exchanged complexions with him and had then entered the sugar beet industry to work constantly by his side.

182. As a continuation of this schedule of Special Cases and yet essentially a sub-classification, is a group, which though numerically small, present such definite characteristics in their accidental simplification that they have been segregated and termed "Cancellation Cases". The reason for this will prove clear when the nature of the results is seen.

Note (1)) I met this father while canvassing the industry particularly discussed in Chapter VIII. All his children were born before he took up that specific line of work, hence the case is included in this list of special cases.

183. CASE 26 (Canc.) The father for thirteen years was in the clothing business and under shelter constantly. He weighed 109 pounds, was of medium complexion and had blue eyes. The mother was of identical complexion. She weighed 119 pounds, was in good health and of normal activities. Two boys made up their offspring. In a case of this kind we may simply cancel the two factors which are practically alike for both parents and the remaining factor, excess protection indoors, is in the father's favor, though in case the mother was of decidedly pronounced secluded habits the balance would, of course, be still more closely drawn.

184. CASE 27 (Canc.) The father had always been in the clothing business with its protective shelter. He weighed 145 pounds and was of medium dark complexion. The mother's complexion was identical and she weighed 125 pounds. We cancel as before, weight and complexion. The remaining factor, shelter, probably overbalances in the father's favor.

1 Boy was born.

185. CASE 28 (Canc.) The father was a clerk working under conditions of protection. He had dark hair and medium blue eyes, and weighed 148 pounds. The mother's complexion was identical and her weight was 130 pounds. Her health was good and her activity normal, allotting to her, probably, a margin of exposure in excess of that of her mate.

3 Boys

constituted the issue in this case. Weights and complexions cancel and the difference in protective shelter in favor of the father finally determined.

186. CASE 29 (Canc.) The father was a plumber and tinner, doing an excessive amount of outdoor work. He weighed about 138 pounds and was a medium blond with blue eyes. The mother was a good housekeeper and stayed at home more closely than the average woman in good health. Complexions were identical and she weighed about 133 pounds. Again weights and

complexions cancel and births favor the mother in her excess of shelter.

3 Girls were born.

187. CASE 30 (Canc.) The father was a checker at a freight station. This involved a considerable amount of exposure under open sheds, along runways and under awnings. The mother weighed about 130 pounds. She had very light red hair and dark brown eyes. In the interview in which I obtained the data for this case, I ventured to assert to the wife that her husband had black hair and dark eyes, and that he weighed not more than 135 pounds. This estimate I based primarily on the fact that her two children who were with her were girls. She answered that I was exactly right as to her mate's complexion and that two days before he had weighed at 136 pounds. The mother was in good health and very active. She admitted being out of doors in spite of domestic obligations to a far greater extent than most mothers. This had always been a custom with her. In this case, exposure and weight factors cancel and complexion governs in the mother's favor with the issue already stated.

SPECIAL CASES RESUMED

188. CASE 31. The father was a brick mason. This naturally involved excessive exposure. He weighed 170 pounds and was of sandy complexion with almost auburn hair. The mother was very dark. She had dark hair and brown eyes and weighed about 160 pounds. She was accustomed to be out doors much of the time, and her appearance vouched for it for she was very swarthy. The father's complexion governed in the issue of

3 Boys.

189. CASE 32. The father was an electrician. This occupation affords a large measure of indoor protection, but in this case the mother was almost a chronic invalid. One girl was the issue. No other conditions were noted here. It seems that the illness of the mother governed through the enforcement of seclusion, since the father

stated that the break in her health occurred two years before the birth of the daughter.

190. CASE 33. The father worked for seven years as a driver on a bakery and milk wagon. He weighed about 185 pounds and his complexion was quite sandy. He had blue eyes.

2 Girls

of six and four years were the issue in this case. The mother weighed about 140 pounds and was a medium light brunette. I marvelled at this situation, which incidentally was about to cause the disruption of the family, for it seemed that the father's weight and blondness should have yielded him preferably a son despite his outdoor work. I was deeply puzzled until one who had long known the family informed me that until the time of their union the mother had been a school teacher!

191. CASE 34. The father had always been in the clothing business. The mother was almost an invalid. She had been ill for years. The issue here was one girl.

192. CASE 35. The father was a grocer. He weighed 160 pounds and had light hair and brown eyes. The mother weighed 150 pounds and had light hair and blue eyes. The tendency towards blondness in the mother, in the fact of her blue eyes, seemed to be the excess factor in producing one girl, as her habits were practically on a par with those of her husband. This is also an instance in which weights and exposures cancel.

193. CASE 36. The father was a minister who had dark eyes and jet black hair. He was a man of excessive outdoor activities, strangely so when compared with his occupation and complexion. The mother was a frail woman of medium complexion and blue eyes. She verged constantly on invalidism, producing

6 Daughters!

194. CASE 37. The father was a young bank clerk and the mother was just out of school. One girl was the issue. There are no data on complexions. The

weights were about equal, approximating 135 pounds. The steady excess protection for the mother in her schooling appears to be the determining factor.

195. CASE 38. The father was a garment worker with indoor protection. The mother lived a secluded life, adhering more closely to domestic duties than the father to his vocation. Two girls were born.

196. CASE 39. The mother had been a school teacher for ten years before her marriage. She had light brown hair and blue eyes and weighed 135 pounds. The father was dark and weighed 155 pounds. He was a captain and all-around boatsman. There were born

5 Girls.

Comment on a case such as this seems unnecessary.

197. CASE 40. The mother was a school teacher. She was a blond with blue eyes and weighing 140 pounds. The father was dark. He weighed 165 pounds and was a travelling salesman. Here are two factors in the mother's favor as against only one in the father's favor. The result:

1 Girl.

198. CASE 41. The father was a travelling advertiser. He was moving constantly and was out of doors most of the time. He had light hair and blue eyes and weighed about 145 pounds. The mother was a tall brunette weighing 160 pounds. She was slightly freckled. In spite of the father's exposure in his occupation, I thought that he had some chance by virtue of his blondness, but upon inquiry I was informed that the babe in the perambulator was a girl and that another child which had died in infancy, was also a girl. By this time school teaching had bobbed up with sufficient frequency to render itself quite spooky indeed, and the very next query revealed the fact that this mother too had been a school teacher for a number of years prior to their union. It later developed that freckles seemed rather indicative of a still higher sex

potential, and we may here allow for a compounding of that factor in the mother's favor.

199. CASE 42. The father lived in Kansas for many years and followed the occupation of a thresher. There were born to his household during those years

10 Girls.

During all this time the mother suffered incessantly with heart trouble, which unquestionably influenced excessive seclusion within her home. At last the father retired from his work in the grain fields, after which

1 Boy was born.

200. CASE 43. The father was a railroad brakeman at Richmond, Indiana. Born

6 Girls and no boys.

201. CASE 44. The father was a railroad man living in Detroit, Michigan. One girl was born. The father had dark hair and blue eyes and weighed 145 pounds. The mother had blue eyes and light hair and weighed 155 pounds. Here all three factors are against the father.

202. CASE 45. The father was a blacksmith. There were born,

1 Son (died at six months of age)
1 Son
1 Son
1 Son
1 Daughter (died at nineteen days)
1 Daughter (died at two days)
1 Son.

The father had always enjoyed shelter in his occupation until the panic of 1893, following which for the first time he was idle for a considerable period and outdoors much more than customary. It was immediately under the influence of this period of idleness that the two daughters were born. As is shown, they died in early infancy.

203. Of the material presented in this chapter there is a total of 251 cases, all noted at random, of which only 7 actual cases (all denoted *) appeared as almost wholly exceptional to the rule of "outdoor exposure against indoor protection". The last two of these seven exceptions are covered in the application of the complexion factor as developed in the treatment of the Special Cases.

204. The general perspective is that when the babies are all girls, either the mother weighs too much, or she is too much of a blond, or she is not out in the sunlight enough, or else the father's weight is too light, or he is too dark in complexion, or he is in the sunlight too much. And, when all the babies are boys, we may view the case from the standpoint of a reversal of the above conditions for either father or mother, or for both.

CHAPTER VII.

Professor Newcomb's Work: Further Proofs on Complexion

205. The Carnegie Institution of Washington, D. C., published in June, 1904, a bulletin (1) of which Professor Simon Newcomb was the author. Professor Newcomb has made no claim whatever to any final basic or fundamental conclusions; to this extent the work is disappointing. Further, a certain mathematical treatment of census and other statistics is engaged in; it is purely academic and practically beyond the layman's comprehension. However, Professor Newcomb shows breadth of mind and fairness of spirit which is inviting. On page 16 of this bulletin, by one of the plainest implications possible in English, he points to the great importance of the examination of birth returns, (sex ratios), in searching for causes. Contrast with this estimate of the importance of statistics, Professor Morgan's total rejection of sex ratios as having any bearing on the problem! (2)

206. Professor Newcomb discusses an abstraction of 2838 families and a total of 13,257 children, and yet from all of this he offers only what he believes to be warranted probabilities. His work indicates that he is searching for abnormal sex ratios but that he cannot find any material of this nature which is to him susceptible of any definite or satisfactory interpretation. It therefore develops that he is looking to a source for data which cannot be found unless we are fortunate enough to approach it with an adequate measuring stick in the shape of a pertinent clue.

207. I stated that, so far, only three facts very closely related to the problem for the human species had

Note (1) "A Statistical Inquiry into the Probability of the Causes of Sex in Human Offspring."
Note (2) Vide "Heredity and Sex" by Thomas Hunt Morgan.

ever been discovered or adduced. (Par. 139.) The first one, the observation by Dr. Romme, was mentioned. In the bulletin by Professor Newcomb the other two come to light. One is in setting up the proposition that very young parents tend to produce an abnormal proportion of male children. Vienna statistics are cited as showing 13% excess of boys born to fathers under twenty-five years of age. For mothers under seventeen years of age there is an excess of boys born to the extent of 171%, (a male sex ratio of 2.71). For Norway, to fathers below twenty years, the excess of boys born is 17%. And for the young parents of the United States, among all the first born children, boys are in the majority by 19%. The total effect of all statistics cited in the bulletin is so disconcerting to Professor Newcomb, that he thinks there has been negligence in the reporting of female births. He attempts to discredit the figures and complains that in the item of young Austrian mothers, (an excess of 171% male births), the total number of cases reported, 26, is too small to warrant any conclusions. This may be true, but it should have stimulated him to go out with notebook and pencil and secure a sufficient quota of such cases.

208. During one period of a few weeks in Detroit, Michigan, I canvassed 187 cases of mothers with their first born. None of these mothers was more than twenty-two years of age, apparently, and in every case the infant was too young to decide its sex independent of inquiry. Of these 187 births there were 56 girls and 131 boys, a male sex ratio of 2.34; not far from Professor Newcomb's citation on Vienna. One will readily agree that 187 cases, taken at random, would be a fair quota, hence it is certain that for very young mothers, or among first born children there is an excessively high male sex ratio. This I consider to be the second fact of importance for the human species.

209. In the first place I noticed in the 187 cases just referred to, that these young mothers were almost

all of light weight, and I pointed out in the preceding chapter that weight is an essential conditioning factor. These young mothers lacked an adequate corporeal screen. Moreover their tissues were tender and non-resistant, easily influenced by whatever meteorological conditions came to bear on the case. Further, the girl of seventeen cannot expect a boy of seventeen or eighteen, and consequently of similarly light weight, for a mate. The father of her first born is much more likely to be twenty-two or twenty-three or even twenty-five, with a heavy lead in weight, while the young woman of twenty-three is more likely to mate with a man of twenty-four or twenty-six, hence he would have much less advantage over her in point of weight than obtains in the first instance.

210. My canvass of the 187 cases in Detroit resulted in a killing of two birds with one stone. This canvass was also conducted along the demarcation line of complexion. The first group, 123 cases of young brunette mothers, showed births of 109 boys and only 14 girls. The remaining 64 cases were of young blond mothers and showed births of 42 girls and only 22 boys. Thus I considered my 187 cases, so divided, as proof of the complexion factor. The indications were strong in the case of the 64 blond mothers that they averaged slightly more in weight than the brunettes.

211. The third fact of close relativity for humanity is in the case of illegitimacy. Professor Newcomb refers in a skeptical strain to this question: "It is a curious fact that in European countries where complete statistics are available, the excess of male births is smaller for illegitimates than for legitimates. The problem of explaining this, which we can scarcely believe to be real, is one which the writer must leave to others." It does indeed impose a severe strain on one's credulity to believe this to be true when no explanation of the phenomenon is offered. I was slow in hazarding even a guess on the case; it was a year and a half after I first encountered Professor Newcomb's comment that I

concluded it was based on complexion and began to look up the evidences nearest at hand.

212. In conversation with the attendant who had charge of all illegitimate cases and records at the Woman's Hospital and Infants' Home in Detroit, I was informed that it was her firm belief, based on constant contact with these cases, that there was no noticeable preponderance of either blonds or brunettes among the mothers. However, she was not able to furnish a complexion count on cases for 1915 and 1916 constituting her most available record. For 1915 there were 83 births; of these, 80 were illegitimates and three were legitimates. The two groups were combined because the margin of legitimates was too small to affect the result. Out of these 83 births, 44 were female and 39 were male. In 1916 there were 98 illegitimates born. Forty-five were males and 51 were females. The status of the remaining two was lost as they were included in a separate schedule of six stillborn of both sexes. Thus far the records of this hospital fully support the claims for Europe, and even go further; for out of a total of 179 illegitimates, 95 were females and 84 were males, an actual excess of females to the extent of 13.1%. This corresponds to about 18.7% in excess of the normal proportion of females among legitimates.

213. The proprietress of a similar institution in Detroit was quite sure that in a substantial majority of the cases which she handled the mothers were blonds. She supplied an original list showing complexions in 34 cases which she checked from January first to September fifteenth, 1918. Of these 34 unfortunate young mothers, there were 21 who had blue eyes; one was designated as light (probably gray); and only 12 had black or brown eyes. The list of these 34 births is not divided to show sex, but the proof already at hand is sufficient to assign in this count as well, a majority of females. The fact that the sex count is for one hospital and the complexion count is for the other, presents

no serious objection since the predominance of females among all illegitimates is now an established fact.

214. The Florence Crittenton Home of Detroit also rendered a statement of all cases coming into that institution between June seventh and September eighth, 1919. This showed a total of 32 cases, of which five were negresses; the latter were rejected because they were monochromatic. This leaves 27 polychromatic cases, of which there were only nine cases where the mother had dark hair and dark eyes. There were 18 cases of blondness; eight mothers had "light hair"; eight had "blue or gray eyes"; and two had "red hair".

215. These developments would seem to go far towards uprooting a lot of orthodox notions about "morals and free will". They impress us more strongly than ever with the conviction that "man is a machine driven largely by forces from without himself." And from these premises we must point out that the care and responsibility of parents for the blond daughter weighs upon them much more heavily than has hitherto been realized.

216. In utter and striking contradistinction to both the McClung and Wilson hypotheses of sex is Professor Newcomb's statement of that which he thinks probable. "The more likely conclusion would seem to be that the part of the father is asexual and that the determination (control or transmission) of sex is entirely the function of the mother." From my own standpoint, I am naturally compelled to take critical issue also with this view. I have already shown in a number of cases, and in some cases several times, where the sex in births in the family changed from male to female and vice versa, and in each of these particular cases I have succeeded in pointing out a definite and corresponding change of the father's habits and environment in harmony with the direction of the change in the sex of offspring, and in each case the relative nature of the change was the same for the production of like sex.

217. While further proofs are yet to be offered, there is no question that the ground is already established for the contention, at least with regard to the human species, that each sex is definitely and solely iso-gametic.

CHAPTER VIII.

The Acid Test: or Fooling Two Sulky Guinea Pigs

218. One of my earliest impulses in taking up this research, was, naturally, to carry out a line of experimental work; and as will be referred to in greater detail later, I worked with guinea pigs for the greater part of 1917 without being able to obtain any results whatever that could be correlated to the hypothesis I had adopted, either for or against it. In all of this work I followed the general practice of exposing one guinea pig to excessive sunlight, usually under glass, while its mate was simultaneously kept constantly in the shade or semi-darkness of a cellar.

219. If the guinea pigs had any particular grudge against me, manifested in their refusal to perform per schedule, they reckoned without their host, for at most their stubbornness served only to delay for a time the most critical and most valuable part of all the work, which was to be carried to completion regardless of their moods. Previously, however, I had reached the conclusion early in 1917 that the one human vocation that came as near parallelling the hypothetical conditions which I expected to impose on the guinea pigs, as could be hoped for, was that of the greenhouse business. I confidently expected then that a canvass of the families of men engaged in greenhouse work would reveal an abnormally high ratio in female births, and possibly higher than could be found in any other definite occupation.

220. In June of 1918 I began a systematic canvass of the greenhouses of the city of Detroit. On the first day I took data on every available family, represented by the men engaged in greenhouse work along Mack Avenue. I had very little idea as to what practical results I would obtain. An excess of daughters to the

extent of 15% or 20% would have been satisfactory. Imagine my bewilderment when, out of nine families recorded there developed a total of nine boys and 26 girls, an excess of females by 188%! This is a ratio of 2.88 for females.

221. During the next few weeks I prosecuted this work vigorously among the remaining greenhouses in Detroit and those in nearby towns, Birmingham, Pontiac, the vicinity of Redford, Ann Arbor, Ypsilanti and Mt. Clemens being included in the canvass. It was not until late in October that I deemed the work complete for four counties.

222. The count of children was restricted to those born while the father was engaged in the greenhouse work, and exceedingly gratifying was the early discovery that in perhaps 90% of these cases the fathers had made this occupation a lifelong pursuit. This category also includes a few cases, probably less than half a dozen, which were voluntarily referred to by those giving their own personal data. These were neither solicited nor rejected. There is also included the count of all dead children if born within the period of the occupation indicated.

223. The percentage of the first day did not continue so excessive by any means; for by some tantalizing coincidence my record of the first day included two families with a total of 14 daughters and only two sons. It was not probable that this would continue throughout the canvass so I did not disappoint myself by expecting it. The percentage calculation, made daily as the work progressed, did dip at one time to 44% excess of females but it turned upward again on the day following.

224. There is a total of 64 of these "greenhouse" cases which will be reviewed seriatim; the peculiarities, points of particular interest and of definite factoral relativity will be noted in many instances. These are not all of the families of men in greenhouse work in the territory covered; a few were absent from their

work on the occasions of visits; but the list does include the families of all men I found then present at the greenhouses. In some cases no detailed data were recorded as the men were too busy with their work to be interrupted by more than a bare question as to the period of their employment and the number and sex of their children. In a few cases, given by second parties, details as to weights and complexions were omitted because they seemed inaccurate. The record contains an entry of two greenhouse cases with two daughters, previously encountered.

THE GREENHOUSE LIST

Covering Wayne, Washtenaw, Oakland, and Macomb Counties, Michigan

225. CASE 1. The father had always been in the greenhouse work. His weight was 147 pounds; he had blue eyes and dark hair. The mother's weight was 120 pounds; her eyes were blue and her hair dark. She was never ill in her life except in confinement. She was quite an active woman who spent much of her time out of doors; it appeared that her exposure quite balanced that of her husband. Their children in the order of their births were

1 Boy
1 Girl
1 Boy
1 Girl
1 Boy
1 Girl
1 Boy
1 Girl.

The sexes in births alternate regularly with a balancing of the factors involved. This case should be compared with Special Cases 2 and 16 in Chapter VI.

226. CASE 2. The entire period of the father's working life had been spent in greenhouse work. He weighed 145 pounds; and had bluish gray eyes. The mother's weight was 125 pounds; she was a brunette.

She was active in outdoor pursuits and recreation until the advent of

1 Boy.

In this case blue eyes for the father and his excess weight determined the child in his favor.

227. CASE 3. The father had always been in the greenhouse work. His weight was 196 pounds; his eyes were brown and he had medium light hair. The mother's weight was 160 pounds. She was a brunette of excellent health. She was a splendid housekeeper; this indicates that in her case there was a large measure of seclusion in her home. Their children were

2 Girls.

Here the father labored under the double handicap of his occupation and his weak complexion. His excess weight is not sufficient to permit the production of his own sex. It developed that the mother had been a telephone operator for an extended period prior to and immediately preceding her marriage; her occupation naturally had involved much protection indoors.

228. CASE 4. The father had always been engaged in greenhouse work. He weighed 140 pounds, had blue eyes and dark hair. His first wife was a blond, weighing 125 pounds. To them were born

1 Girl
1 Boy
1 Girl.

Upon the death of his first wife the father married her sister, a woman of the same type. There was born by the second wife

1 Boy.

229. CASE 5. The occupation of the father had always been that of a worker in a greenhouse. He weighed 175 pounds and was of a very dark complexion. The mother was in good health, weighed 150 pounds and was likewise of a very dark complexion. The issue were

1 Boy
7 Girls
1 Boy.

230. CASE 6. This father was the first child mentioned in the preceding case. He too, entered work in the greenhouse and remained in that occupation all his life. He weighed 160 pounds and was a blond. The mother's weight was 150 pounds. Their children were

7 Girls.

231. CASE 7. The father's only occupation had been that of a greenhouse worker. He had dark hair and brown eyes and weighed 145 pounds. The mother was of the same type and weighed 125 pounds. There were born

2 Girls.

Here the father's occupational exposure was to great a handicap for his weight and for his weakness in complexion.

232. CASES 8 and 9. These two cases were observed during 1917; they consisted of two "greenhouse" families with one daughter each.

233. CASE 10. The father had always been in greenhouse work. He had black hair and greenish-blue eyes. The mother's weight was 143 pounds while that of the father was 165. The mother was of the same type as the father. The issue were

4 Girls.

234. CASE 11 (cited by the father in Case 10.) The father had worked for eight years in a greenhouse. He had four daughters, two of which were credited to this period of his occupation.

235. CASE 12. The father had been engaged in greenhouse work all his life. He was a blond with blue eyes. His weight, in old age, was 200 pounds. The mother had black hair and brown eyes; her weight in old age was 240 pounds. To them were born

1 Boy

Note: Cases 5, 6 and 7 were given by the father in case 4, who stated that it had always seemed very strange that femininity was so persistent among their families, and that they had often remarked about it, and had, themselves, wondered if greenhouse work was the cause of it.

1 Girl
1 Girl
1 Boy.

236. CASE 13 (1). The father's only occupation was that of a greenhouse worker. He had one boy.

237. CASE 14. The father had always been a greenhouse worker. His weight was 155 pounds; he had dark brown hair and blue eyes. The mother's weight was 127 pounds; she was a brunette. Their offspring were two boys.

238. CASE 15. The father had always been in the greenhouse business. His weight was 230 pounds; he had black hair and blue eyes. The mother was a blond with blue eyes; she weighed 140 pounds. The children were

1 Boy
3 Girls.

All of the latter died in infancy. Here is a remarkable case in which the importance of the various factors is strikingly exemplified. The father's excessive weight and his blue eyes gave him one son in spite of the exposure incident to his occupation, and came near to giving him a total of four sons. There is little doubt that the death of all three daughters in infancy with such startling certainty may be attributed to their having been born too near the line of sex demarcation. The blondness of the mother made daughters a possibility in spite of her comparative deficiency in weight.

239. CASE 16. Both father and mother in this case had been actively engaged in work in greenhouses. The father's weight was 160 pounds. He had black hair and gray eyes. The mother's weight was 130 pounds; she had brown hair and brown eyes. There were born to them.

2 Boys.

This may be considered an excellent cancellation case.

Note (1) This case was given by another employee. No other data were secured.

The exposure as a result of their occupations was equal for them. Complexions practically cancel and a preponderance of weight determined the issue for the father.

240. CASE 17. The father had been in greenhouse work for nine years. He weighed 165 pounds. He had dark hair and blue eyes. The mother's weight was 110 pounds; she was a brunette. The occupation of the father seems to be the only factor to be considered in this case. One girl was born.

241. CASE 18. The father had always been in this kind of work. His weight was 140 pounds. He was a blond with blue eyes. The mother weighed 115 pounds and was a medium brunette. One boy was born to them.

242. CASE 19. The only occupation of the father was that of a worker in a greenhouse. He weighed 175 pounds, had medium dark hair and hazel blue eyes. The mother's weight was 130 pounds; her complexion and eyes were of the same type as the father's. The issue were

3 Girls.

243. CASE 20. The father was a worker in the greenhouse and had been during all of his working life. He weighed 138 pounds; he was a blond with blue eyes. The mother's weight was 120 pounds; she was somewhat darker in complexion but her eyes were blue. Born

2 Girls (one dead).

244. CASE 21. The father had always been in the greenhouse work. The mother had worked at his side in the same occupation. She was always in good health. The father's weight was 160 pounds. He had dark hair and brown eyes. The mother weighed 130 pounds. Her complexion was of the same type as that of the father. There were born

5 Boys
3 Girls.

245. CASE 22. Both husband and wife had been engaged in greenhouse work. The wife helped her husband. The father's weight was 155 pounds and he had dark hair and brown eyes. The mother weighed 145 pounds and was of a like complexion. The issue here were

3 Boys
1 Girl.

246. CASE 23. The father had always been engaged in greenhouse work. His weight was 190 pounds. He was a blond with blue eyes. The mother weighed 150 pounds; she too was a blond with blue eyes. In this case were born

1 Boy
5 Girls.

247. CASE 24. The father at marriage weighed 135 pounds. He was a blond with blue eyes. The mother weighed 150 pounds. She was a brunette. The occupation of the father had formerly been that of a workman on a railroad. During this occupation there was born

1 Girl.

Following this, both father and mother entered work in a greenhouse. There was born next

1 Boy.

This case shows by the sex of the first child the effect of the mother's protection at home and the father's exposure on the railroad. With the second child the factors of exposure came to a practical balance and the stronger complexion of the father governed.

248. CASE 25. The only occupation of the father had been that of a worker in a greenhouse. (No other data were secured.) The issue was one girl.

249. CASE 26. The father had always been in this kind of work. (No other data were obtained.) There was born one boy.

250. CASE 27. The father had always worked in a greenhouse. (No other data were recorded.) The children were

By the first wife
1 Boy
and 1 Girl.
By the second wife
1 Boy.

251. CASE 28. The father had been in work of this nature during all the period of rearing a family. He weighed 155 pounds and had dark hair and dark eyes. The mother weighed only 110 pounds and she had dark hair but blue eyes. There were born

1 Girl
1 Boy
1 Girl
1 Girl.

252. CASE 29. The father had always worked in a greenhouse. He weighed 155 pounds; he was a blond with blue eyes. The issue in this case was one boy.

253. CASE 30. The father in this case had four sons who were born before his entry into work in a greenhouse. This is dealt with in the Special Case in Par. 181.

254. CASE 31. Father's weight 150 pounds; blond. Mother's weight 145 pounds; blond. This couple had three children, one of which, a girl was born after the father began his work in a greenhouse.

255. CASE 32. The father had always been in business in a greenhouse. He had blue eyes and a sandy complexion and weighed 140 pounds. The mother's weight was 160 pounds; she was a brunette. There were born here

3 Girls.

256. CASE 33. The father had always been in greenhouse work. (No other data were obtained.) There were born in this case

1 Girl
1 Boy (died in infancy).

257. CASE 34. The father had always been in greenhouse work. There were born here
2 Girls.

258. CASE 35. The father had always been engaged in work in a greenhouse; the mother actively assisted him. The issue were
3 Boys (2 died in infancy).

259. CASE 36. The father had always been engaged in work of this nature. There were born
4 Boys.
2 Girls.

260. CASE 37. The father had always been in the greenhouse work. There were born
1 Boy
1 Girl.

261. CASE 38. The father had always been in greenhouse work. The issue were
4 Girls
2 Boys.

262. CASE 39. The father's work had always been in a greenhouse. There were born
2 Girls.

263. CASE 40. The father began work as a carpenter and building contractor. He weighed 165 pounds and was of very dark complexion. The mother weighed 100 pounds and was a blond with blue eyes. Two boys were born while the father was engaged in the first occupation. After he entered employment in a greenhouse two girls were born.

264. CASE 41. The father had always been engaged in greenhouse business. His weight was 190 pounds; he was a blond with blue eyes. The mother had a like complexion and weighed 140 pounds. The issue were
3 Boys.

265. CASE 42. The father had always worked in a greenhouse. In this case were born

4 Boys
1 Girl.

266. CASE 43. The sole occupation of the father had been that of a worker in a greenhouse.

3 Girls
1 Boy were born.

267. CASE 44. The father had always worked in a greenhouse. One boy was born.

268. CASE 45. The father had always been in the greenhouse business. His only children were

2 Boys.

269. CASE 46. The father had always been in greenhouse work. He was a blond with blue eyes; his weight was 150 pounds. The mother was a brunette weighing 200 pounds. There were born to this couple

3 Boys
3 Girls.

270. CASE 47. The father had always been in greenhouse work. The issue were

3 Girls
1 Boy.

271. CASE 48. The father had always been in greenhouse work. He had dark hair and blue eyes and weighed 180 pounds. The mother's weight was 100 pounds; she had a medium light complexion and blue eyes. Their children were

3 Girls
1 Boy (died in infancy).

272. CASE 49. The father had always been engaged in work in a greenhouse. His weight was 170 pounds; he was a blond with blue eyes. The mother was a brunette with a weight of 160 pounds. Here was born one boy.

273. CASE 50. The father had always worked in a

A Peep at the House of Mystery

(Cut supplied through courtesy of Lord and Burnham Company, Chicago—builders of greenhouses and conservatories.)

greenhouse. There were born

2 Boys (one died)
1 Girl.

The data in this case were given by the father in Case 49. No other facts were given.

274. CASE 51. The father had always been in greenhouse work. (This case was given by an employee who supplied no other data.) The issue were

4 Girls (one dead)
2 Boys.

275. CASE 52. The father had always been in work of this kind. (No other data.) There were born in his family.

2 Girls (one dead).

276. CASE 53. The father had always been in greenhouse work. His children were

2 Boys
2 Girls.

277. CASE 54. The father had always been in greenhouse work. Children which comprised his family were

1 Boy
1 Girl.

278. CASE 55. The father had always been in the greenhouse business. His children were

3 Girls
4 Boys.

279. CASE 56. The father had always been engaged in greenhouse work. He weighed 147 pounds and was of very dark complexion. The mother's weight was 135 pounds; she was also of very dark complexion. Their issue were

4 Girls
1 Boy (dead).

280. CASE 57. The father had always been in greenhouse work. The issue were

2 Boys
6 Girls.

281. CASE 58. The father here was one of the sons of the parents in Case 57. He had also been in the greenhouse all his working life. He weighed 162 pounds and was a blond with blue eyes. The mother's weight was 132 pounds; she was a blond. There were born to them

2 Girls.

282. CASE 59. The father had always been in greenhouse work. His weight was 155 pounds. He had a rather dark complexion and blue-brown eyes. The mother was a brunette weighing 125 pounds. There were born

1 Boy
1 Girl.

There seems to be a fair balancing of factors here. The father's weight offsets his weakness in complexion and his exposure, while his mate, who assisted in the greenhouse work only occasionally, enjoyed sufficient comparative protection to offset her light weight and weak complexion; thus the family was evenly divided.

283. CASE 60. The father had always been in the greenhouse business. His children were

3 Boys (one dying in infancy)
3 Girls (two dying in infancy).)

284. CASE 61. The father had always been in the greenhouse business. There were born

1 Girl
1 Girl
1 Boy.

285. CASE 62. The father was occupied in the greenhouse business. There was born in 1918

1 Girl.

286. CASE 63. The father had always been in the greenhouse business. The children were

2 Girls.

287. CASE 64. The father had always been in the greenhouse business. There were born

3 Boys
1 Girl.

288. Thus runs the record of 64 families engaged in greenhouse work. Out of 206 births there are 123 girls as against 83 boys born under that occupation. The normal ratio between sexes in births would, in the case of a count of 123 girls, call for 129 boys. Therefore in these 64 cases there is a shortage of 46 boys, or 36% below normal. For a count of 83 boys under average or normal conditions there should be but 78 or 79 girls; but in these greenhouse cases the total of 123 girls makes an actual excess above normal of 44 girls. In the final reduction of these figures they show 55% of female births above the normal proportion for the whole population in all occupations combined.

289. In disclosing to us the potent function of sunlight in the control of the sex of the child to be, the greenhouse canvass thus brings us to the threshold of the realization of Francis Bacon's prophecy or dictum, published in his "Novum Organum" in 1620, when he said,

> *"The passage from the miracles of nature to those of art is easy; for if nature be once seized in her variations, and the cause be manifest, it will be easy to lead her by art to such deviation as she was first led to by chance; and not only to that, but others, since deviations on the one side lead and open the way to others in every direction."*

290. Fixing thus, indisputably, the relation of this industry to the sex of children coming into the family, the greenhouse is delivered into our hands ready made, a most suitable and most admirable instrument by which we shall lead Nature to do by art that which she has always heretofore done, apparently by chance, and bring the fixation of the sex of the child-to-be within the domain of conscious control.

291. In the early spring of 1920 a canvass of all the greenhouse families in Muskegon and Muskegon Heights, Michigan, was made. Here were noted 5 families with a total of 10 girls and 8 boys born while the fathers were engaged in active operation of the greenhouses; this is an excess of 25% of girls. There were also at Muskegon two other families who were engaged in greenhouse work but their greenhouses were used only for the purpose of sprouting celery during a comparatively short season. These two cases were omitted from the greenhouse count proper, although the total for those two families alone was 3 boys and 4 girls.

292. One case in particular among those of the Muskegon Heights families is of especial interest. Formerly the father was employed in a pharmaceutical laboratory. While in this protected occupation one son was born. In March, 1913, they took up greenhouse work in Muskegon Heights. Less than two months later, in May, the second son was born. In July 1916 was born the first daughter. In 1918 another son was born and in 1920 another daughter. In this case I have no exact data as to the mother's relation to the greenhouse industry, but it is probable, that the mother too, prior to conception of the last son, had been in the greenhouse to a considerable extent owing to the novelty of the new occupation. Out of five children in this family, three, (two girls and one boy), were born while the father was at work in the greenhouse.

293. A canvass was conducted in Minneapolis of greenhouse families there. (1) Much of the city was covered by districts, and the cases were recorded seriatim, without selection or rejection. Counting those births occurring only while the fathers were engaged in greenhouse work the record for 21 families showed about 27% excess of girls born.

Note (1) The entire city could not be covered at that time.

Note: An attempt was made to obtain a postal card canvass of the families of delegates to the National Convention of American Florists and Ornamental Horticulturists, held in Cleveland in August, 1920, but the executive committee disapproved.

CHAPTER IX

The Law of Sex Determination for the Human Species

294. Sunlight is the sole prime factor, or motive power, in the differentiation of sex in offspring.

295. Sunlight functions as a sex determinant only upon the original parental germs, prior to the moment of conception.

296. No influence, acting after the union of the two gametes, can modify the sex predisposition arising from the mandate of preconception forces.

297. While the exact mode of the relation of sunlight to the gamete is not yet known, its virtual effect is that of an anaesthetic acting only upon that particular character within the gamete which transmits sex. It seems probable that differentiating effects reach the gamete only by a previously induced condition of general somatic metabolism.

298. Any substance or condition, either internal or external to the organism, which affects the metabolising action of sunlight upon that organism, will affect the ability of the organism to transmit its own sex. Complexion and weight are now known to be definite, predisposing conditions, as well as many external factors such as cloudiness, shelter, (housing), and clothing qualities. Food, by serving to increase the corporeal size, acts as a proximate condition, and may even yet be shown to have a more primary bearing on the case.

299. The sex of any coming child will depend upon the effective preconception relation of each parent to the action of sunlight. If the father has been effectively subjected to sunlight in excess of the mother's effective subjection thereto, the child will be a female; and if the

conditions be reversed, a male will result. When all conditions for both parents have been equal, or nearly so, it will result in the sex of the child being cast too close to the line of sex demarcation. In such cases the anatomy of the child becomes a veritable battleground of the two opposing sex stresses struggling for domination. If this condition is sufficiently critical the child cannot survive it. It follows then, that the child with the strongest and best vitality is the product of two parents whose respective sex potentials, at the time of conception, are at opposite extremes.

300. The production in one birth of bisexual twins or triplets presents no particular difficulty in the application of these principles for we are not compelled to assume that all the gametes of the same sex are at exactly the same potential when their respective conjugations occur. (1)

Note (1) This question was touched on more broadly in Par. 54.

CHAPTER X

Guinea Pigs and the Food Factor

301. In Chapter I there are references to the work of other authorities involving the question of food relativity, but we gain from them no adequate concept of the real amount of work done on this item. In all the vast expanse of endeavor by biologists to ascertain the basic principles governing the issue of sex, and to accomplish its conscious control in births, no factor has been so constantly manipulated or so persistently pursued as has that of food. The volume of work in which food has been the chief or sole factor dealt with, probably surpasses by several times the amount of attention that has been given to all other factors combined.

302. A few isolated results have been reported, but so far no developments involving food have warranted the pronouncement of a definite law or principle on a food basis. So discouraged does Professor Morgan become in his work, "Heredity and Sex", that he exclaims, "But food theories will go on for years,—or as long as credulity lasts." Nevertheless, since learning that sunlight is the prime determinant in these processes we do not regard "food" quite so hopelessly as does Professor Morgan; for even though we do not know exactly what relation food may bear in any particular case, we have gained a vantage point from which we can more intelligently approach the food problem.

303. Long before seeing any account of Dr. Oscar Riddle's work, (1) and before finding Doncaster's citation of Phillip's observation on ducks (2) I had set up the proposition that weight is a condition fraught with a determining urge. And what produces weight but the food consumed by the individual? Do we not thus have immediate food relativity? Dr. Riddle, by innumer-

Note (1) See Par. 41-42. Note (2) See Appendix.

able most careful and exhaustive tests has shown that fats and phosphorus in the blood stream and in the ovum are intimately correlated with the issue of sex, at least in the case of pigeons, and he has also reported for humans the extent of these items in the blood stream. How do hydrocarbons and phosphorus enter the system save by the food supply?

304. In just the proportion in which food builds up or maintains weight or size in the individual, so does it tend to build up or maintain the sex potential. But I do not believe that this manifestation, which we may figuratively say is mechanical, is the only mode by which food accomplishes this result. Numerous instances in organic phenomena show that food may occasion very profound chromatic manifestations. For example, to turn the plumage of the white parrakeet a flaming yellow, the Brazilian native has only to diet the bird for a time on alligator fat. And it has long been known possible to give the coat of the common canary a decidedly reddish tinge by an addition of cayenne pepper daily to its food. When we meet manifestations of color in the epidermal tissues they constitute a physico-reciprocal of light. Hence food, through its chromatic qualities, may introduce into the tissues and into the blood stream certain resistances to the metabolising influence of sunlight thereby setting up that which I postulated in 1917 as the "chromo-circulatory screen."

305. It was therefore with agreeable surprise that I noted in a volume (1) by W. J. Hammer a statement that the human blood stream is opaque to ultra violet light. Upon this evidence it may be regarded as much more than probable that a chromo-circulatory screen does enter into the equation, and that both somatic and gametic metabolism are set up inversely, to some extent, to the density, richness, color or certain chemical qualities of the blood stream. Evidence on this question should be sought in the case of children born to an anaemic parent.

Note (1) "Ultra Violet Light" by W. J. Hammer. Pub. by D. Van Nostrand & Co.

306. I mentioned before that I conducted some work with guinea pigs in 1917; (1) altogether I kept some five or six pairs at work, maintaining careful segregation for projected matings, and carrying on from time to time, careful reversals of mates from bright sunlight to partial darkness. Periods of segregation were two and three weeks long. To secure definite results these creatures should have mated within twenty-four hours after having been placed together again. The test was repeated at least twenty times but not in a single instance would they mate until six to eight weeks had elapsed after the end of the period of separation. Nothing in the way of a result was obtained at any time which would either verify or disprove the hypothesis.

307. Constant observation of the animals, however, did disclose a few noteworthy facts. First, those subjected to sunlight refused absolutely to eat any white food. Carrots they considered gum drops and beets, mince pie. They revelled in grass and the darker green the better. Their preferences even extended so far as to exclude white cabbage in favor of the purple which they ate as readily as beets. Occasionally they would nibble a bit of apple, but they ignored white bread and in general they preferred to sulk or starve when I attempted to force white food upon them. This I came to associate with the idea of the protection of the sex potential through a possible setting up of a chromatic screen in the animal's circulatory system, although neither on this basis could I ascertain any related issues in sex proportions in their case.

308. Further, in the consumption of salt (NaCl), of which the guinea pig is ordinarily fond; there was a considerably smaller quantity of rock salt consumed by those protected from light than by those exposed during my tests. This bore no relation to the respective sizes of the creatures, for the largest one I had ate no salt whatever when isolated in the shade. I made three tests of salt consumption and a reversal of mates in each case,

Note (1) Chapter VIII.

as well, from light to darkness and vice versa, and in every case there was a heavy drop in salt consumption on the part of the one in semi-darkness. There was no error in these salt determinations; precautions were taken to prevent loss by hydration. Obviously this phenomenon calls for thorough investigation as to its significance which I feel may also be related to the chromo-circulatory screen in terms of sex. All work with guinea pigs was abandoned when I finally decided to base the question upon the greenhouse canvass. (Chapt. VIII) q. v.

309. Among the principal mammals roaming at large and unrestrained, it is probable that there occurs no abnormal difference in any respect in the food supply of mates but with animals under domestic restraints, and in the case of some in which mates are frequently separated by considerable time and environment factors, serious differences in nutrition may and doubtless do occur.

310. While much speculation remains on the question of food, *per se*, yet I think it clearly shown that it has only a marginal relation, which simply means that in many cases we may ignore it and deal with the question of exposure alone; while in some cases we shall come to be able to hasten results in constructive control, or lessen the time factor involved in treatment, just as we come to interpret better and better, food and its actual relation to the question.

311. It is far more than possible that the difference in the qualities of an ultra winter diet and those of an ultra summer diet constitutes the best available margin for ascertaining true food relativity. The reasons for such a view are most potent. In the first place, every organism in existence possesses to considerable degree the ability to adapt itself and its functions to its environment, and changes, to conform with this principle are frequently made with startling celerity. Assuming therefore, that the human organism constructs within

and for itself a screen for the sex potential, we can at once grasp the obvious fact that the strength of this screen or sex protector would tend to vary somewhat in proportion to the actual needs of the sex economy; and since sunlight is the determinant, the strength of this screen will be less in winter than in summer. Finally, it would indeed be difficult to recognize the source of such a variation outside the item of food, which we know varies more with seasons than with any other factor for adults.

CHAPTER XI

Constructive Control

312. Since we have to contend with one factor, nutrition, the influence of which is not yet exactly known, it is necessary to out line as many modes of dealing with it as logic would dictate. Late in 1917, while studying the possibility of the existence of a chromo-circulatory screen, I entered among other notes, the observation that, "it is quite probable that meat, drained of its blood content and used as is our custom today, is quite devoid of any chromatic qualities in terms of sex." In December, 1919, American news reports cited the work of Dr. Pezard, through the Academy of Sciences, (Paris) to the effect that in his experiments with chickens he found that both the reproductive and fighting qualities of the rooster disappeared when he was fed a heavy meat diet. Thus, those who have always insisted that pugnacity is necessarily a sex-linked characteristic, must admit hereby the forging of a wholly new link in the chain of accumulating evidence.

313. Professor Thury, in the case of cattle, pointed to the increasing hydration of the ovum descending from the ovary as an urge towards maleness in offspring. Later work by Hertwig and Kuschekewitch correlated the production of males in frogs with increasing hydration of the egg. Only a few years ago, King, by an experiment with toads for female production, proved also the correlation of that sex with the lack of water in the egg. Still later, Dr. Riddle showed the same relation between hydration and sex in the pigeon's egg. The citation by Professor Thury, more than any of the later ones, satisfies us that the same consideration probably holds true for the human species. Therefore it now remains to be seen whether the sex potential of the human ovum can be affected by a certain measure of water (high or low)) in the mother's

diet. This question is open to attack, and empirical methods should be instituted to decide the merits of it. It would appear reasonably certain, (if the facts for other mammals are admitted as a criterion) that moisture in environment bears no relation to the water content of the ovum, since Dusing (Par 10) has shown for sheep that moisture (in environment) affords an urge towards the production of female sex.

314. Logic would also urge the advisability of a thorough test of the seasonal influence of foods by continuing one mate on a winter diet and at the same time compelling a heavy springtime exposure out of doors prior to conception, while exactly reversing these conditions for the other mate. A thorough test of chromatic against achromatic foods might yield results in some cases and it is altogether likely that an applied contrast between foods on a chromatic basis would yield us almost the same results as would a seasonal contrast in foods. Being certain, as we now are, that one factor of control through food is available wherever we can modify the food supply, we shall use this relativity,—as well as any other means within the limits of prudence, for altering the weight of the individual. Meanwhile, manipulating the other angles of the case with respect to complexions and exposure to sunlight. Aside from the weight relation of the food supply, and with respect to chromatic or any other pertinent characteristics of food, our course of least resistance will be to balance the diet for the two mates.

TIME FACTOR

315. Since the issue of sex in offspring is based upon three principal interlocking factors for the individual parent, exposure to sunlight, complexion, and weight, it will be seen at once that in no case is any one of these conditions ever absolute. The value of one is always relative to the values of the other two, and this situation is doubly compounded because of its application to each parent of the pair instead of to one only.

316. The greatest difficulty in any approximation to the value of any factor has been relative to the time element. It is evident that if the question be asked, "How long will be required to alter the sex potential of a father to insure the production of a son as against a previous quota of daughters by giving him a change from out of doors to complete seclusion indoors?" it will be necessary for the questioner to state the weight, complexion and previous exposure factors for this father, and for the mother in the case as well; and in addition to all of this we must also know to what extent we may be able to modify the mother's factor of exposure at the same time in the direction of the desired change.

317. Nearly all the graphic work dealt with on Plates 1 to 28 inclusive disclosed, apparently, a three month average "lag" in the responses of the sex ratio curve to the oscillations of the cloudiness curve. This, I take it, indicates that the condition of the sex potential of the individual parent in an average case, at or just before the moment of conception, is the climax or result of that parent's condition or habit for about three months prior thereto. This is an indication that for a certain percentage of cases in a population group, the essential change is very likely to occur within a surprisingly short space of time.

318. In all of the eleven years included in the curves for Boston, there is a heavy urge towards an excess of female births in the first quarter of the year. In eight years it occurred faithfully in February; in two years in March; and in one year it seems to have been in January. This points to a seasonal variation with a cycle one year long. The conclusion therefore seems to be that in most instances, among the human race, in average types and sizes, an intelligent manipulation of the exposure factor for a period not more than a year prior to and ending with conception would produce the objective in results. While it is true that peak D of male births in June 1877, (PLATE 6), represents a differentiating ef-

fect upon but 11.5% of the total births of both sexes for that month, still, it must be remembered that none of these births took place as a result of tests deliberately set up, but that the effect occurred only opportunely as domestic and vocational influences happened to combine for a certain quota of couples, and moreover, only in those cases in which personal factors afforded the causal correlative. Thousands of individual cases everywhere show successive births into the family with repeated reversals of sex occurring not more than a year apart,—disclosing an ample margin of chance to accomplish the same result consciously in no longer time than a year, and what is still more likely, that when all other conditions for both mates are fairly equal, a reversal of habit or exposure for no longer than the equivalent of the time of gestation (9 months) will suffice to accomplish a reversal of sex in offspring.

319. There are some cases in which extreme weight and blondness will demand probably two or three years of grilling exposure out of doors, and as has been intimated, there are some auburn cases in which a great or unlimited amount of exposure will not effect a change in sex potential, and in which only a proper counterbalancing of weight and complexion at the time of choosing a mate will result satisfactorily.

320. Because of the basis of relativity for the entire problem, no absolute statement can be made as to the time factor. My judgment on this phase of the problem, as evidenced below, is based upon my constant observations since the inception of this work in 1916, and I offer it as a basis for further study. There follow a few hypothetical examples, reconstructed from actual conditions in cases encountered.

321. EXAMPLE 1. The man weighs 145 pounds and has light hair and blue eyes. He has been at work for two years in a factory, well sheltered. His sex potential is as high as it can be forced by casual conditions short of employment in a mine. He chooses for a mate a

young woman with black hair and brown eyes; she is in good health and has never been engaged in any definite occupation. She weighs 120 to 130 pounds. She has been normally active with an average margin of outdoor exposure for a woman of her type. The first-born will be a boy if it comes within eighteen months after their union. If in two years more this mother has gained 10 pounds in weight and has yielded largely to indoor seclusion, and all conditions have remained stationary for the father, the second child by an even chance will be a boy or a girl. If at the time the first child was born in this case the father had taken to an outdoor pursuit and had lost 10 pounds weight and all the conditions for the mother had remained stationary except her increasing domestic seclusion then the second child would easily have been a girl.

322. EXAMPLE 2. The woman weighs 125 pounds and has light hair and blue eyes. She has been teaching school for three or four years. Her sex potential is as high as it can be forced. She contemplates union with a man who weighs 155 pounds and has black hair and eyes. He has been farming for several years. If a son is expected in this case, as first-born, it will first be necessary for the woman virtually to exchange occupations with the man for an entire year prior to the first conception. Assuming in this case, however, that the woman weighs 170 pounds, the reversal in occupations should cover two years time and every effort should be made to reduce the woman's weight and at the same time to increase the man's weight. If at their union the woman weighs 140 pounds and the man 150 and no modifications ever occur in their conditions of shelter or exposure, there is indeed but small chance that any but daughters will grace this home.

323. EXAMPLE 3. The man weighs 140 pounds; he has worked for several years in a store. He has black hair and brown eyes. His union is with a woman employed similarly for several years. She has brown hair and blue eyes and weighs 120 pounds. After their

ALICE ELIZABETH JACKSON

(At Four Months of Age)

Niece of the author and one of my successful predictions

marriage her habit merely changes from store to home. Their first-born will be male or female by an even chance and the subjection of mother and father to excess exposure of sixty days out of doors alternately in advance of each succeeding conception will produce a regular alternation of sexes in the succeeding births.

324. EXAMPLE 4. If the woman has red hair and blue eyes and weighs 130 pounds, and expects to produce sons for a man who is a dark brunette, she must see to it that he weighs from 175 to 210 or 225 pounds. It is very doubtful if any exposure variations would accomplish anything for this woman, if, instead, she chose a mate otherwise similar to the one just described, but of only 140 to 155 pounds in weight.

325. EXAMPLE 5. If the father weighs 160 pounds, is medium blond with blue eyes, and the mother is a dark brunette of 115 to 125 pounds and the father has been constantly indoors, resulting in a quota of "boys only" it will probably require eighteen months to two years of exposure out of doors for the father, and a reduction of weight by 10 to 20 pounds to give some assurance of a daughter. If, on the other hand, in this case the mother remains exceedingly close at home and can increase her weight by 10 or 15 pounds the period of treatment can probably be reduced to a year.

326. The efficiency of my judgment upon these factors may be viewed more advantageously in the light of the fact that since researches and observations began early in 1916, I have predicted the sex of births in 27 cases and events proved true to the prediction in 22 of these cases. Nineteen predictions were made for boys and 18 were correct. Eight were for girls and four were correct. Twenty-six predictions were for the first-born and only one related to a second-born child.

327. Particularly in the field of biology it is most difficult indeed to state a principle in terms of a universal law which has no exception. Life manifests

itself, much as other phenomena, along the lines of least resistance, and because of this we have constantly to deal with or explain certain "urges" or preferential channels along which life chooses to exert itself and express its functions; and the chief mistake of the past has been to ignore or discredit these "urges" in search for a more remote, arbitrary or abstract "law."

328. *In the whole category of phenomena which relates to the issue of sex in offspring, casually, among the polychromatic races, there is probably nothing more certain than that the first-born of the brunette mother will be a son, or that there will be daughters among the offspring of the blue-eyed mother before the close of the period of her reproductivity.*

329. We canot pass from the discussion of constructive control without considering again the vigorous and repeated claims on the part of many professional observers that the issue of sex is affected by the question of pre- or post-menstrual fertilizations. That this is a generally operative principle can be wholly refuted by statistics combined with the moderate admixture of common sense. The first consideration is the indisputable fact that copulations among the human species occur exceedingly haphazard, and that it would require but a moderately sized unit of population, one or two thousand families, to show absolutely, either by the general law of chance, or by private interrogation, that there are exactly as many couplations, or fertilizations taking place one, two, or three days before the menstrual period as there are during the first, second, or third day subsequent to that period and yet this same quota will yield at times 200 or 300 per cent excess of one sex over the other in births. The contention has been that pre-menstrual conceptions produce females and that post-menstrual conceptions produce males.

330. With reference to the case of Mercer county, Ohio, PLATE 15, in which in May, 1916, were produced male and female births at the rate of 100:229, if post-

menstrual conceptions govern the production of males, we are forced to the utterly untenable belief that in August, of 1915, to every 100 fertilizations before menstruation there were 229 occurring after that period. Or take the case for January for the same unit; 10 female births occurred to six male births. Can any sane person believe that fertilizations in April of 1915 occurred in this proportion on the corresponding side of the menstrual period? We are dealing here with from 5000 to 7000 families.

331. Consider from this viewpoint also, such as births for December, 1904, PLATE 22, Kandiyohi county, Minnesota, in which occurred three male births to every female birth! In the year 1905 for the city of Lubec, Maine, PLATE 25, the male sex ratio was .56. Must we accept further this dictum, and believe that in Lubec, throughout 1904, almost twice as many conceptions occurred prior to menstruation as afterwards? The case of Red Jacket, Michigan, for 1911, PLATE 26, would show similar illogical conclusions were we to accept this "law" relating to pre-menstrual and post-menstrual conceptions. I believe this depiction of such an absurdity is quite sufficient to dismiss the argument for the case as in any wise belonging to the category of "laws."

332. While it has been adequately shown by others that the sex potential of the ovum drops as it descends and takes up water, thus moving towards the preferable production of a male, and that ovulation, (the extrusion, descent and discharge of an ovum), is synchronous with menstruation, still if any observer, authority or practitioner has encountered a case in which sex in offspring has been modified by consideration for the menstrual period, he has found only an opportune manifestation adapted to his particular case which might not occur again in two or three hundred cases.

333. By the adoption of some exemplary percentages, it can be shown when such a result may or may not

be expected. We shall deal with a blond woman of excessive weight, 175 pounds. From a fair margin of indoor habit her sex potential is temporarily high and her sex potential capacity is always high. Her actual sex potential may be represented by 350 points of strength. Then the potential of her ovum as it leaves the ovary is also at 350. By the time it finishes its travel and emerges from her body its potential has dropped to 280. Suppose her mate to be a man of 140 pounds weight, with dark hair and eyes and that his sex potential, disregarding possible variations in the potential of his spermatozoa, is at 255. It is evident that no pre- or post-menstrual considerations can alter the issue here, for a daughter would be the inevitable result, since the sex potential of the father never equals even the lowest point reached by that of the ovum of the mother in its entire somatic journey.

334. But let us suppose another case and involve Dr. Robinson's contention for a variable potential in the spermatozoa as well (1). The sex potential of the mother, and of ovum in situ, is 225 points, and the drop during the somatic journey is to 190 points. Stale spermatozoa from the father are at 200 points, and the mother's ovum does not pass below 200 points until after menstruation. It is evident here that the chances for a male child are excellent from a post-menstrual fertilization; and any pre-menstrual fertilization under these conditions will truly favor a female. But supposing fresh spermatozoa from the father to be at 230 points, it is evident that in the employment of such, male offspring would always result regardless of the menstrual period.

335. It may be stated that advantage may be taken of this factor of pre- or post-menstrual relativity, in constructive control, if there are intermittent intersections of the gradients of sex potential drop of the maternal and paternal gametes. But if no such intersections, or mutually reversing values occur at any time in con-

Note (1) Vide Par. 37.

nection with the menstrual period, then work with this factor becomes of exceedingly small avail, and we are thrown back upon our basic resource of exposure to and protection from sunlight with the secondary modifications of weight and complexion.

336. The greenhouse has afforded us the most admirable instrument producing desired reversals of sex issue, and the more so since it seems to be the best definite pursuit which could afford the mother constant exposure to sunlight during adverse seasons of the year.

337. During the closing months of 1919, Dr. Alice Hurst, late of Detroit, Michigan, discovered at least two cases in which factory employees, subject constantly to the light of the mercury vapor arc-lamp, had been producing daughters only. After the men left the factory and were free from exposure to this light, rich in actinic rays, sons were born next in each case. One of the men entered the indoor employment of a grocery store. Dr. Hurst believed the indications of direct relativity between the artificial light and the sex of offspring to be very close in these cases. It is therefore not improbable that certain values are to be uncovered in the field of artificial lights, though such recourse is not to be recommended in the case of the human species.

Note: Dr. Hurst died in Schnectady, N. Y., June 14, 1920, broken down from heavy over-work incident to her constant and conscientious ministrations in the medical field at Detroit.

CHAPTER XII.

A Crisis: Hetero-Gametism or Iso-Gametism for the Human Species

338. When an organism of either sex develops reproductive germs of both sexes it is said to be "hetero-gametic"; but if it produces a germ of only one sex, and at that, only of its own sex, it is said to be "iso-gametic." The reader has no doubt, long ere this, charged me with the inconsistency of discussing the problem at issue upon the assumption of iso-gametism for the human species without having proved it; and that I have done so in the face of the fact that both the McClung and Wilson hypotheses of sex—although based only on observations for some lower orders—have strongly urged, by implication, that the human female is asexual (without a sex determinant) and that the human male is hetero-gametic. These two hypotheses which are quite similar in their general import have probably received more widespread support than any other modern views on the subject.

339. However, at least two authorities of weight, in fact of prime rank, have shown aversion to these hypotheses, as we have seen; Leonard Doncaster (1), by direct complaint, and Professor Simon Newcomb (2) by the statement of a converse probability. And Professor Morgan himself, easily dean of the old school, has already shown the insecure foundations of these hypotheses in his admonition that sex may be determined by entirely different modes in different cases. If, as is claimed, the proof is final that among birds the female is the hetero-gametic member of the pair, and if, as McClung and Wilson insist, that among spiders the male is the hetero-gametic member, then out of these two opposing facts (?) which shall we accept as the rule for homo? The case for birds is urged just as strongly as is that for spiders, and birds are far closer to the

Note 1) Vide Par. 39. Note (2) Vide Par. 216.

human species in the line of organic evolution. If the problem is to be solved by criterions from lower orders, why go so far as spiders for an example—or for fact?

340. Professor McClung has already admitted the "lameness" in the situation (1) therefore I think we can move on to the evidences for iso-gametism in the human species with far less consideration for the ghosts of past views, than ordinarily would be required.

341. Doncaster complained (Par. 39) that hetero-gametism for certain of the lower orders had not, in his opinion, been absolutely proven. On the other hand there are not wanting some strong indications that iso-gametism does exist far down the scale of organic life probably including some if not all of the birds. (See appendix.) But whatever the case may be for any of these lower orders, we have, in homo, arrived at a much more complete segregation of the respective sex gametes due to the onward urge of evolutionary processes, and this may be the basis of the marvellous powers, capacities and abilities of which man finds himself the special possessor, and even more—this may be the principal basis for the strong expression of monogamy in human institutions. If, as one at times is almost tempted to think, there is a motive, an infinite, constructive consciousness behind the course of evolutionary events, may we not readily assume that "It" has been driving at a gameto-genetic structure just as much different from all which has preceded as is the intellectual structure?

342. It was only by the assumption that the human mother produces a gamete of only one sex—and female at that—that I was led to the discovery of the relation between rainfall and female births as already shown for several counties which are ultra-agricultural; (rainfall in the country districts being largely the index of preferential housing in the mother's favor)—and therefore I consider the premise sustained and proven by this strikingly corroborative evidence.

Note (1) Vide Par. 31.

343. It is inconceivable to the last degree that any such phenomena as is shown by the parallels in Chapter III could develop if the human parent, either father or mother, were possessed of both male and female gametes; for here is shown the result of antithetical metabolism and it is difficult to see how this antithesis could exist, much less be discoverable, if both gametes were carried by the same parent.

344. In his conversation with me upon the subject, Dr. Robinson expressed himself as being thoroughly convinced of the facts which he cited, stating that the manipulation of two or three cases, of which he knew, upon the theory of stale versus fresh spermatozoa, had yielded definite reversals of sex in offspring. Here too is some evidence that the human father is iso-gametic only, for we can not admit the possibility of commingled gametes, of opposite sex, moving in opposite directions of potential in response to the same metabolizing agency.

345. I have been successful in showing definite conditions of excess housing for fathers as urging the preferential production of male children, and of a similar condition for mothers as urging oppositely, towards females (1). This would seem to afford most powerful evidence in favor of iso-gametism. Personal interpretation of it may be open to question but the facts of the phenomena are beyond dispute, and the hetero-gametists will find themselves hard pressed to reconcile their views with the cold facts.

346. While these are not all the evidences which may be considered in favor of iso-gametism for the human species, they are among the strongest. In another chapter we shall deal with cases in statistics which also uphold this contention, inasmuch as they show reversals of sex for and against fathers as fluctuations occur in certain definite industrial environments for and against the potential of the male gamete (2).

Note (1) Vide Special Cases in Chapter VI.

Note (2) "For" and "against" should be interpreted on the basis of exposure to and protection from sunlight.

CHAPTER XIII.

A Consideration of Statistics

347. Out of the huge volume of work done by all students to date upon the question of sex causation or differentiation, a very considerable proportion has been expended along the line of statistics in births; this has been practically fruitless.

348. If I understand Professor Morgan correctly, he entirely discredits birth statistics (sex ratios) as throwing any light whatever upon the problem of causation. Professor Newcomb took a stand almost exactly opposed to that of Professor Morgan, pointing to the importance of a close study of abnormal variations in the sex ratio. Leonard Doncaster did not succeed in interpreting any birth statistics but he admitted that there is a large mass of such, which gives weight to the view that something in environment, some factor outside the germ cell does influence its capacity for sex transmission.

349. In the Quarterly Journal of Economics Professor William Z. Ripley discusses sex ratios (1): "Almost half a century ago Wappaeus and Legoyt noted the statistical fact that the relative number of boys to girls born in the country was greater than in the urban districts.

350. "It would seem that this interesting generalization may now be accepted as an established fact." Ripley cites Fabris as saying that for 1876 Italy showed about 2% more boys in the rural than in the urban sex ratio. He cites Levasseur for the statement that for France from 1801 to 1865 the excess proportion of boys for countryside as against the city was from 1% to 2.3%.

Note (1) 1908-09, pages 175, 8, "Sex Ratios at Birth in Town and Country."

351. Ripley himself says that out of 55 large cities in Germany, six in 1895 and seven in 1896 actually showed a net majority of female births, and he commits an inexcusable violation of logic when, in speaking of this condition for Germany, he says that it is a "law" which "holds good." It is not and cannot be a law so long as a single city, town, village or hamlet makes a contrary showing, and he has not afforded in his article, statistics for every city, town, village and hamlet in Germany; hence he is not in any position to call his generalization for Germany a "law." Moreover he is well aware of the fact that biological principle knows no such thing as nationality nor geographical boundary lines, and he continues his inconsistency by next proceeding to discuss conditions in Russia in which he states that the major condition for Germany, his "law," is reversed, there being 39 out of 49 Russian provinces in which the proportion of boys born in the city was actually greater than the proportion of boys born in the country. Now Professor Morgan and Professor Pike would shake hands and chuckle with glee at this seeming flaw in statistical logic, and Professor Ripley would be left disconsolately following only a series of three-toed tracks along the ground, imagining that they and the chicken which made them were one and the same thing, wholly oblivious to the fact that an "urge" in life manifestations, while it may be of great value in leading to the discovery of a law, is itself an exceedingly different thing from a law (1).

352. Ripley makes no attempt to discuss fundamental details, nor does he speculate to any unwarranted extent. He closes by urging that the more general tendency towards female births in the cities (in western countries) may result from certain sociological peculiarities of the opposing groups of parents; and if he had

Note (1) Huxley long ago commented on alcoholism as being in some way correlated with an increasing proportion of male children. I myself had encountered strong indications of it quite two years prior to learning of Huxley's observation. It is therefore of the highest probability that the indolent habits of the enormous proportion of vodka drinkers under the old Russian regime, is responsible for the excess urban male birth rate referred to by Ripley. This phenomenon would seem to offer another powerful indication of isogametism for the human father.

only used the word "industrial" instead of "sociological" he would have pulled much of the card house over on himself. But perhaps it is not stretching charity too far to acknowledge that the latter term may include any concept which the former conveys.

353. Professor F. H. Pike summarizes and briefly discusses most of the views of modern students but neither does he offer any basic or final conclusions. One phase of his paper is devoted to a very superficial and misleading glance at statistics on a general scale. He lists the sex ratios (nation wide) for a large group of modern nations showing that in every nation male births are in an actual majority, and that this ranges, in its variation, within the narrow limits of something like 3% to 7%. He does claim however that this state of affairs does not throw any light on the question and is quite skeptical of any values in statistics at all. Thus he also commits the inexcusable error of hiding, in summarized figures, the identity of the tiny unit of territory which may continue steadily for years the production of 9, 10, 12, 15, or 20% excess of males in births, or on the other hand, of some unit of only one or two square miles which at times may jump to 35 or 40% annual excess of females in births.

354. I readily concede the strength of the complaint that figures make dry reading, nevertheless we are seeking an insight to the problem in hand, hence we must look more closely at its detailed aspects than have those who, for so long, have proclaimed the worthlessness of statistics for the purpose. There will follow complete statistics on births for the state of Pennsylvania for the year 1914. (1) These returns on births present a most admirable segregation on the basis of similar political divisions of territory.

355. For the entire state during 1914 there were 219,542 births divided into 113,180 males and 106,362 females; a male sex ratio of 1.06. The total for that

Note (1)) Supplied by Dr. Samuel G. Dixon, State Commissioner of Health.

group of cities, the population of which was 5000 or over, was 64,656 males and 60,687 females, a male sex ratio of 1.06. The total for the group of municipalities the population of which was less than 5000 each was 15,104 males and 14,236 females. Lastly are given the totals for all units of strictly rural territory combined, there being 33,420 males and 31,439 females; a male sex ratio of 1.06. It seems but little short of a miracle that the sex ratios of all these separate totals should be exactly the same,—1.06. The state of Pennsylvania for 1914 should be just as valuable material as any other unit of territory when it comes to a question of the presentation of an example, and here at the very first glance, Ripley's boasted "law" of excess males for the country and excess females, or an abnormal proportion of females, for the city, is in a condition of total collapse.

356. But we have only begun. There are 66 counties in this state, and with regard to rural districts there were 15 in which there was an actual excess of female births, 50 in which male births were in the majority, and 1, rural Bedford county, in which the two sexes were exactly even. Of the 15 rural communities which produced an excess of females, there were 5 in which this excess was less than 5%, 4 in which it was between 5% and 10%, 5 in which it was over 10% and less than 20% ; and in the one remaining (Fulton) county it rose to 34 1-10% excess of females. A close review of the entire list of 145 cities of a population of 5,000 or over, showed only one, Ashland, which succeeded in producing a higher proportion of females than rural Fulton county. Ashland went to 43 1-10% excess of females. And again Professor Ripley's "law" recedes both on the score of rural Fulton county, and in the case of Ashland, for Ashland is a comparatively small city and under Ripley's "law", if it produced an excess of female births at all, it should do so only by a very small margin, whereas it is far ahead of the greatest cities in the state which show any female ratio higher than the normal. This case of Ashland is absolute proof that neither social nor

psychological conditions are basically or primarily connected with the issue of sex ratios.

357. Out of the 50 counties in the state which showed an excess of male births in the rural districts alone, there were 13 in which this excess was less than 5%. There were 17 in which it was between 5% and 10%. There were 13 in which it was 10% or over but less than 20%, and there were 7 in which it was 20% to 26 6-10%. Summarizing these 66 rural units, by a close inspection of the decimals on the basis of 1.053 male sex ratio as a standard, it is found that 31 of them violate Ripley's "law" by producing too many females.

358. For Pennsylvania in 1914 there were 145 municipalities of a population of 5,000 or over. Of this total there were 103 which produced an excess of male births, while only 41 produced an excess of female births. One, the town of Freeland, produced an equal number of males and females. Again Ripley's "law" fails as will be detailed.

359. Of the 103 cities producing this male excess there were 27 in which males were in the majority but by less than 5%; there were 19 cities in which the excess was 5% or over but less than 10%; and out of these two groups, a total of 46 cities, there were only 29 in which the male sex ratio, to be precise, was less than 1.053. The remainder of 17 stood as exceptions to Ripley's "law". There were 19 cities in which it was 10% or over but less than 15%; 15 in which it was 15% or over but less than 20%; 8 in which it was 20% or over but less than 25%; 9 in which it was 25% or over but less than 30%. Three other cities produced respectively, 35 1-10%, 32 7-10% and 36 7-10% excess male births, while Steelton, Knoxville and Huntingdon produced the high excess, in male births, of 41 3-10%, 40 8-10%, and 44 8-10% respectively.

360. Of the 41 cities which produced an actual excess of female births there were 21 in which it was less than 5%; 10 in which it was over 5% but less than

10%; 5 in which it was over 10% but less than 15%; and three more cities produced an excess of females of 15%, 17 3-10% and 16 9-10% respectively. Mt. Pleasant went to 27 2-10% and Ashland, as mentioned before rose to 43 1-10%. (1)

361. Out of all of this, the greatest abnormality in sex ratios which occurs in Pennsylvania, is the case of Huntingdon which was cited: excess males of 44 8-10%, —contrary to Ripley's "law". Of the 66 rural districts, 47% of them, and of the 145 municipalities, 49% of them failed Professor Ripley's prescription, and one cannot but agree that this constitutes a most serious quota of exceptions.

362. With this statistical state of affairs in mind, the position taken by Professor Pike and many others, that birth sex ratios are too nearly uniform to be of much importance, becomes enveloped in a thick haze of mystery. It is absolutely impossible, for most units of territory, to develop facts by totals covering a long period of years. On the other hand, the greater the area of territory totalled in one blanket ratio, even for a short length of time, the more futile becomes our search for an interpretation. I have succeeded already in showing the logic of this attitude toward statistics, for the tracing of cause and effect in the Graphs in Chapter III has been done principally month by month and for a small unit of territory.

363. Turning to the question of the real interpretation of sex ratios we find a forecast of it in Chapter V on Economic Relativity. It is already far beyond dispute that modern industry, with its concentration and segregation of vast groups of potential parents has come to draw sharp delineations in the issue of sex in offspring, and that the tendency of a community to produce boy babies or girl babies in excess, revolves immediately around the question of whether, in that com-

Note (1) In the Pennsylvania statistics for 1914 there are a few items missing; there are some instances in which for a month or two, sometimes returns for one sex or for both sexes are missing. I have carefully estimated, by comparisons, that the total shortage amounts to about 19 births for the state.

munity, a considerable majority of fathers are employed steadily indoors, or whether they are employed steadily outdoors, and on the other hand, whether there is any definite group of women in industry.

364. A review of the report of the Commissioner of Labor and Industry and of the State Department of Mines, for Pennsylvania for 1914 will disclose items of interest, although these data are by no means as detailed and satisfactory as those which enter into the curve work given elsewhere in this volume.

365. Rural Berks county showed in births for 1914 a male sex ratio of .98, while its capitol, the city of Reading, showed 2% more girls,—a male sex ratio of .96. The city of Reading is a heavy railroading center, comprising the shops and yards of the Reading railroad. For the whole of Berks county there are employed by the entire volume of business and industry 30,730 males and 10,198 females. Subdividing the male total, 21,987 are employed in indoor occupations and 8,743 are employed in outdoor occupations. Berks county runs high in the number of females employed in industry. There are therefore:

21,987 (men indoors or units of value for male sex production)
as contrasted to
8,743 (men outdoors or units of value for female sex production)
10,198 (women employed indoors or units of value for for female sex production)

18,941 (total units for female sex production.

While here, superficially, there is not literally shown a majority of units for excess female sex production in Berks county, still the total is not far behind that for male sex production and the case seems suspiciously

Note: A few small lectures on the subject of this work were given in 1919-20. In one of these lectures at Muskegon, Mich., I touched the topic of Railroading. One of my auditors presently arose and excusing the interruption said to the rest, "My friends, let me tell you now that you are for the first time hearing the truth: about 6 families of my relatives were of railroaders, and out of a total of 26 or 27 children for the group—I am the only male." This gentleman escaped the gathering before I could learn his identity.

favorable. A higher excess of females in Reading than in its rural environs points to the effects of railroading on its population. There was no coke or coal production shown for Berks county.

366. For 1914 rural Blair county showed an excess of male births of 10 9-10% and the city of Altoona produced an excess of females by 3%, making a male sex ratio of .97. The total of business and industrial employees for all of Blair county was 17,418 and of female employees 1,280. These are segregated as follows:

13,543 (men employed outdoors or units for female sex production)

1,280 (women employed indoors or units for female sex production)

This makes a total of 14,823 units for female sex production as contrasted to 3,875 men employed indoors, or units of value for male sex production. Altoona is the heaviest railroading city in Pennsylvania and in its excess of female births the corresponding reputation of railroading is again vindicated.

367. In all of these summaries there are included, of course, some modifications. It is obvious that we cannot speak strictly of 13,543 men employed out of doors, for combined in that total for railroading as an outdoor occupation there are numbers of men who work in the shops and roundhouses and who have a considerable margin of indoor protection, though perhaps not so much as for those in machine shops not connected with the transportation industry.

368. The report on labor and industry affords no absolute basis for segregating these two elements. They are classed under the caption of "Railways and Public Service." This obviously includes city firemen and policemen in Altoona, mail carriers and the like. The same is true of the city of Reading. In Blair county in 1914 some 475 men were employed in the coal mines. These would be considered as units for the production of male sex in offspring. The amount of labor engaged in coke production was negligible.

369. Rural Butler county in 1914 produced a male sex ratio of 1.228, and the city of Butler produced a male sex ratio of 1.069. The total number of male employees in the industries of Butler county was 5,054. The total of females employed was 204. The number of males engaged in coal mining was about 1,500. There was no coke production for 1914. Of the 5,054 male employees cited, 716 worked out of doors in minor pursuits, while 4,338 worked indoors. To summarize:

1,500 (men in mines or units for male sex production)
4,338 (men employed indoors or units for male sex production)

5,838 (total units of value for male sex production) as contrasted to a total of
920 (total units of value for female sex production)

These latter were subdivided into 716 men employed out of doors and 204 women employed at definite indoor industries. 1.07 is a very frequent male sex ratio for cities and manufacturing activities and the city of Butler at 1.069 is a very close approach. The heavy ratio of 1.228 for the countryside is due to coal mining beyond question.

370. Cambria county, (rural section), produced in 1914 in births, 1,376 males and 1,206 females; this makes a ratio of 1.14 in favor of males. The city of Johnstown produced 1,119 males and 1,075 females, creating a male sex ratio of 1.04. East Conemaugh produced 134 males and 116 females, which makes a male sex ratio of 1.155. Totalling these figures for rural Cambria county and for the two cities a male sex ratio of 1.099 is the general result. Employed in the business and industry of Cambria county were totals of 32,292 males and 764 females. There were also 23,300 males employed in the coal mines. There were 820,000 tons of coke produced in 1914 and I consider this as involving outdoor labor on the part of about 1,600 men. Of the 32,292 males employed in business and industry, 29,683

were indoors and 2,609 were outdoors, and there were 764 females employed indoors. For Cambria we have:

23,300 (coal miners or units for male sex production)
29,683 (men employed indoors or units for male sex production)

52,983 (total units of value for male sex production)
as contrasted to
4,973 (total units of value for female sex production)

The latter were composed of 1,600 male coke burners, 2,609 men employed otherwise out of doors and 764 women employed indoors. This gives a perspective of the causes for the generally high male sex ratio of 1.099 for the entire county. The rural residence of coal miners points to the high male sex ratio of 1.14 in the countryside. Farming plays little or no part in this abnormal ratio for the agricultural population is probably less in Cambria county than in almost any other county in Pennsylvania. The United States census for 1910 indicated that only about 10,800 people constituted this element.

371. Rural Clinton county in 1914 produced a male sex ratio of .89 (an excess of females), and the city of Lockhaven produced the heavy male sex ratio of 1.32. Employed in the business and industrial pursuits of the entire county were 5,639 males and 337 females. Of the males only 1909 were at work indoors while 3,730 were at work out of doors. Clinton county is listed as heavy on railroading and public service and in the production of cement rock and fire clay and in the manufacture of brick and tile. Every one of these lines demands much outdoor exposure for those so employed and the character of the employments indicates that they lie largely in the rural part of the county, in which according to the returns, the heavy excess of female births occurred.

372. The city of Lockhaven is given as being largely engaged in general manufacturing in various lines. The number of males working indoors, 1909, would seem to relate principally to the city of Lockhaven,

hence the excess of male births there in the ratio of 1.32. The number of women employed, 337, was of small import. There was no coke production and coal to the extent of only about 400 tons was mined. There are probably no other two contiguous units of territory in the state in which there arises a sharper distinction in terms of sex production or of industry, for the industry of the city is practically all under shelter while that of the rural districts is almost all out of doors. Even the manufacture of brick and tile is carried on in sheds open largely to the weather, because of the heat thrown off by the kilns.

373. Out of 5,639 males employed in the county there would be about 4,085 in the rural districts and about 1,554 in the city. (1) Since 1,909 males throughout the county were employed indoors, it is probable that, rurally, about 3,985 were at work outdoors, and about 100 indoors. This, then agrees with the heavy excess of female births in the country districts.

374. There were 1,554 men employed in the city wholly indoors and probably about 255 outdoors. Within the city, therefore, were only 255 (men outdoors) plus 337 (women working indoors), or a total of 692 units for the production of female sex as against 1,554 units for the production of male sex; hence the city, from its sheltered manufacturing produced the heavy male sex ratio of 1.32. Clinton county for 1914 stands as an insuperable obstacle to Professor Ripley's "law".

375. The city of Ashland attracted our attention on account of its heavy excess of female births in 1914. There were born 83 females and 58 males, a female sex ratio of 1.43. Ashland itself is an anthracite center. In 1913 there were about 1200 men living in Ashland who were miners. During that year they suffered more from idleness than did any other class of labor. There were engaged in other lines little more than a nominal number, i. e. about 150 men employed outdoors in super surface work, and about 300 women in definite industries.

Note (1) This estimate is based on apportionment of population.

The miners lost from one to three days a week from their work. In this therefore, we catch the first glimpse of the reason why Ashland, with a background of coal mining, produced this heavy excess of female births. With it is carried one very important consideration, namely the highly artificial sex potential which mining induces, and its sudden drop when the group of miners, through idleness, are excessively subjected to sunlight above ground.

376. The two cities of Gilberton and Shenandoah, in 1914, produced, respectively, 29% and 20% excess of males in births. Almost nothing but mining is carried on in or around these places.

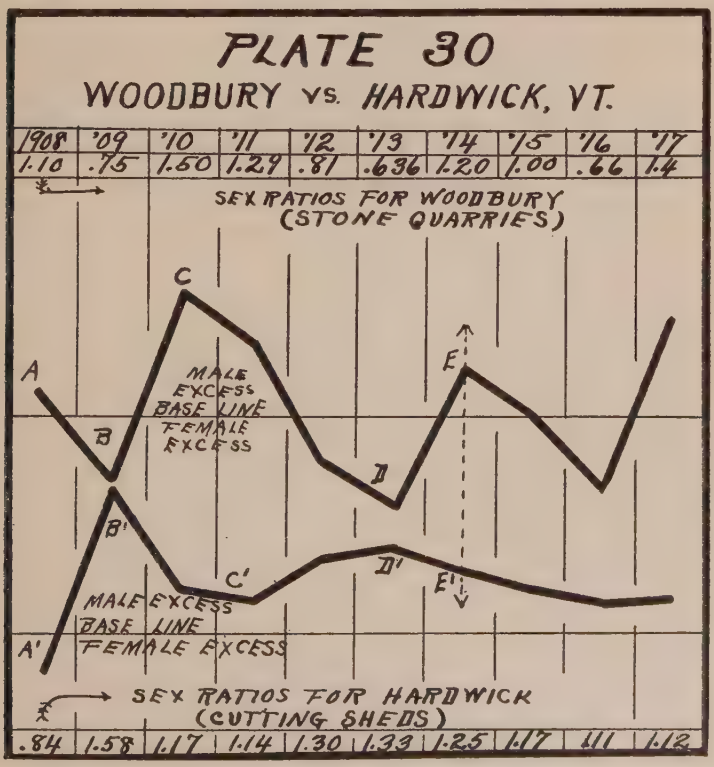
I have succeeded in a reduction of a large number of units for Pennsylvania, outlined as here exemplified on the basis of indoor as against outdoor labor for both sexes and wherever facts could be obtained, the method of analysis has been very largely satisfactory. The case should be given careful consideration from this viewpoint by those who have hitherto denied significance to statistics.

377. The influence of stone quarrying cannot be overlooked. The city of Barre, Vermont, is termed the "granite center of the world." Granite, in various forms composes 85% of the industrial production of the city. 60% of all stone producing territory tributary to Barre lies within the corporate limits of the city, and about 60% of all the quarrymen in Washington county live in the city of Barre. There is of course a large element of labor under shelter in the cutting sheds but this too, at least in summer is subject to some exposure in the yards about the sheds. Some of the quarries reach a depth of 300 or 400 feet, so that in the shade of these high walls some labor is more or less sheltered. The general result is that for 1914-15-16 and 17, the city of Barre produced in births, 640 females and only 646 males. This gives the low male sex ratio of 1.009, or 27 female births above the standard ratio.

378. For the same five years the six quarry cities

and towns of West Rutland, Proctor, Pittsford, Dorset, Swanton, and Barre, combined, produced 1635 females and but 1626 males; a male sex ratio of .98 and an excess above normal of 91 female births.

379. PLATE 30 should afford ample proof that I am not in error in the statistical method adopted. Here are given the sex ratio curves for the towns of Woodbury and Hardwick, Vermont. These two villages are five miles apart. All the quarrying is done in Woodbury and there is no other work engaged in. The stone is hauled to Hardwick and there cut and dressed. Thus practically all the labor in Woodbury is exposed out of doors while most of the labor in Hardwick is under shelter in the cutting sheds. Therefore, in sex production, there is an antithetical result. When labor was idle



in both places in 1908, Woodbury moved to an excess of boys and Hardwick to an excess of girls. A year later when industry in both towns was accelerating, Woodbury moved to an excess of female births at B and Hardwick to an excess of male births at B′. This antithesis continued for six and a half years. It broke as 1915 aproached and the great world change came on. However, three times during the ten years the quarry town produced an annual excess of female births, while Hardwick with its cutting sheds produced a surplus of male births every year except 1908. Again the average male sex ratio for Woodbury for ten years was 1.034 while Hardwick showed the much higher average of 1.199.

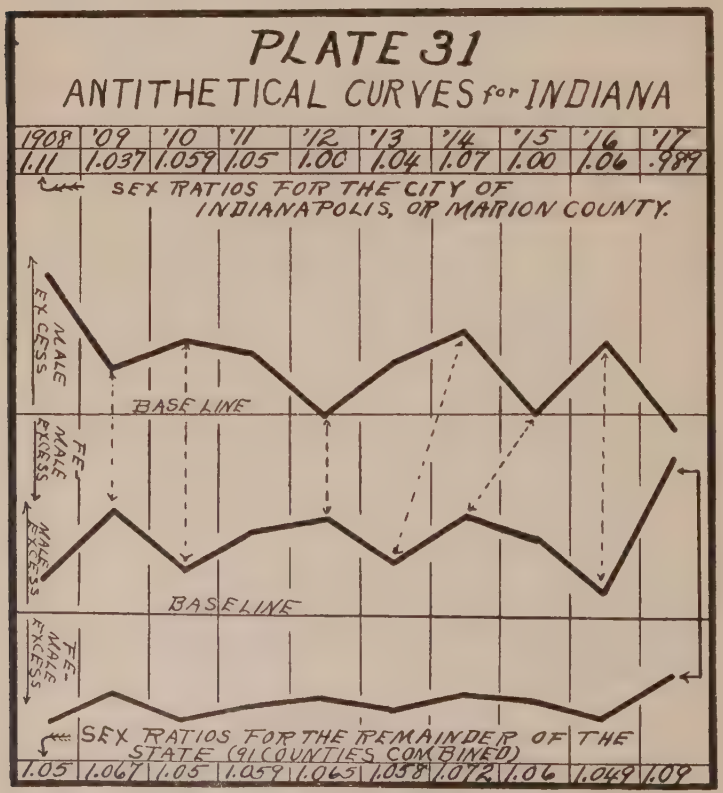


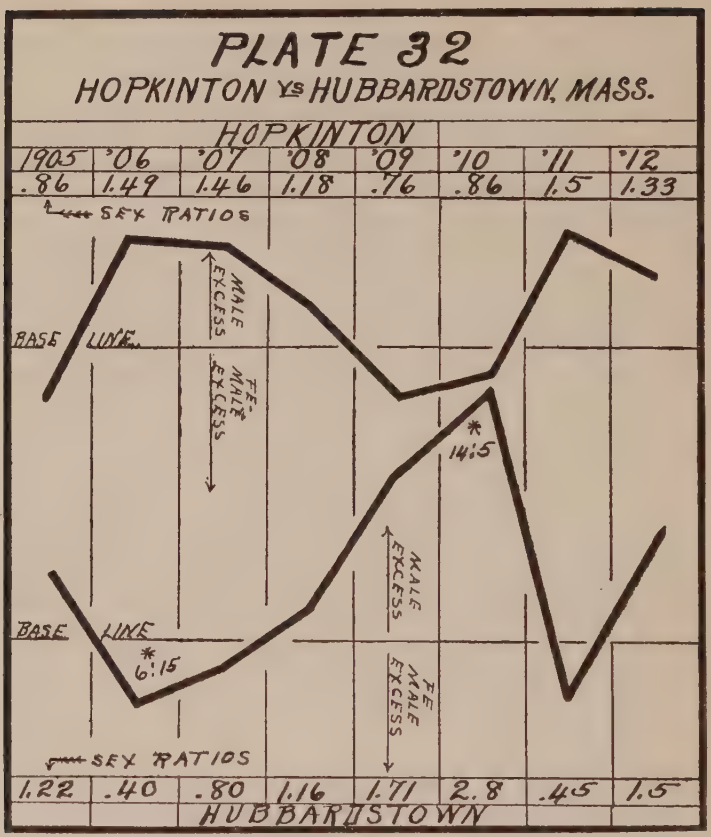
PLATE 31
ANTITHETICAL CURVES for INDIANA
1908 '09 '10 '11 '12 '13 '14 '15 '16 '17
1.11 1.037 1.059 1.05 1.00 1.04 1.07 1.00 1.06 .989
SEX RATIOS FOR THE CITY OF INDIANAPOLIS, OR MARION COUNTY.
MALE EXCESS
BASE LINE
FE-MALE EXCESS
MALE EXCESS
BASELINE
FE-MALE EXCESS
SEX RATIOS FOR THE REMAINDER OF THE STATE (91 COUNTIES COMBINED)
1.05 1.067 1.05 1.059 1.065 1.058 1.072 1.06 1.049 1.09

380. Antithetical results are also shown on PLATE 31 for Indianapolis, Indiana, which is 90% of Marion county, and the sex ratios for the other 91 counties of the state combined. The lower curve is the true sex ratio curve for the 91 counties. Since it covers a large territorial area the shape is more nearly flat. By exaggerating the serrations of the curve a little, a result is obtained comparable to the curve for Indianapolis alone. Here, for ten years, a city of housed industry moved in opposition to an area in which agriculture is preponderant, and the two curves pulsate exactly the same number of times during the whole ten years, although for some unknown reason a slight acceleration occurred in the curve for the 91 counties as we approach 1913 and 1914. This is probably due to especial economic or industrial strains in those years of depression.

381. PLATE 32 shows a perfect sex ratio antithesis running for eight years between Hopkinton and Hubbardstown, Massachusetts. (1) I have secured no industrial data for these two towns, but I am quite satisfied that all of these cases in which antithetical characteristics develop afford ample proof as well that external causes are basic to the phenomenon of sex differentiation in offspring.

382. When Leonard Doncaster spoke of "two nicely balanced tendencies" he had in mind processes within the germ cell only. He never dreamed that any such condition could exist between two diverse industries with sex as its issue as is revealed in the case of Jasper and St. Francois counties in the state of Missouri in 1915. By the United States census of 1910, in each of these counties exactly 83% of the population was engaged in business and in lead and zinc mining, and only 17% was engaged in farming, and for 1915 the male sex ratio in births was exactly the same for each county!—1.16.

Note (1) The case of Hubbardstown, in which in 1906 there were 15 female births to 6 male births, while in 1910 an extreme reversal took place, there being 14 males to 5 females, is further evidence against the hypothesis of bilateralism and against pre- or post-menstrual relativity. Here is a pair of curves which almost speak aloud a definite precise external agency. No plea of "coincidence" or selective fertilization can obtain in this case.



383. Lawrence and Monroe counties in Indiana are the scenes of vast operations in the quarrying of limestone. In 1910 the total population of these two counties was 54,051. Out of this population about 23,121 people are dependent upon the quarry industry in these two counties. For 1913-14 during which there was a deplorable depression in this industry, the two counties produced in births a male sex ratio of 1.01, and in 1915-16 when conditions were improving and production was rising, true to quarry traditions, the male sex ratio dropped to .959, an actual excess of female births.

384. The city of San Bernardino, California is an ultra railroading center; there is practically nothing here but railroad shops and service employees. In 12 years, 1906 to 1917, 1549 female births occurred while there were only 1550 male births. This is a male sex ratio of but 1.0006. And in 1917, due to the excess stresses in transportation arising from the demands of a foreign war, San Bernardino went to the highest point in the production of daughters,—a male sex ratio of but .85.

385. Milford township in Hillsboro county, New Hampshire, is a center of heavy quarrying. For three years, 1915-16-17 there were 118 female births and but 114 male births; this is a low male sex ratio of .966. During the three years the male sex ratio of the entire county was low, being but 1.019. This is probably due to an excessive amount of female labor in the shops and factories, since manufacturing is carried on here to a large extent.

386. Sunapee township in Sullivan county, New Hampshire, presents a state of affairs which calls for close study. At the outbreak of the war in 1917 the town of Sunapee had a population of 1,071, while three villages, George's Mills, Burkhaven and Wendell had a total of population of about 280. The area of the township is about eight square miles and the estimated farm population is 300. This gives a total township population of 1,651. This would make the figure 330 a fair approximation of the number of men who might be termed heads of families. The birth figures for this tiny territorial unit follow:

			Male Sex Ratio
1915	6 Males	12 Females	.50
1916	3 Males	4 Females	.75
1917	1 Males	5 Females	.20

This is an excess of 400% in female births for 1917 alone and an average of 110% excess female births for the entire three years. Of 1651 people in this township, 1071 or practically 2-3 live in the village of Sunapee, hence we are dealing with an urban population. In view of Ripley's "law" calling for an abnormal proportion of females in

municipalities we are totally at sea in this case for we have one of the very smallest of municipalities producing an excess of female births which no city of reasonable size has ever equalled for such a length of time. Ripley's "law" again fails and the question of urban as against rural residence for parents does not involve basic considerations. What are the facts in this case? The town clerk of Sunapee estimated that about 65 men in the town were strictly indoor workers and that 12 women were engaged in one industry. For the other three villages in the township the following estimate is made:

George's Mills	10	men	employed	indoors
Burkhaven	6	"	"	"
Wendell	4	"	"	"
Total	20			
In Sunapee	65	"	"	"
Grand Total (entire township)	85	"	"	"

This leaves of the 330 men in the township, 245 whose activities for most of the year are out of doors. Out of 60 farming families it may be assumed that there are 20 cases in which the mothers are constantly indoors and these are units for female sex production. Assume that the outdoor activities of the other 40 would reduce the value of them to about 30 units for female sex production. In the four villages there are 270 mothers who, having no definite outdoor pursuit, will be counted as units for female sex production also. These data reduce to the following form:

UNITS for Female Sex Production

245 (men out of doors)
12 (women in one industry)
20 (farmwives constantly indoors)
30 (available units out of 40 farmwives working partly outdoors)
270 (city wives constantly in the shelter of the home)

577 Total units for female sex production.

This should be contrasted with only 85 men working indoors in the entire township, who are the only visible units for male sex production. Sunapee township is the first unit of territory to yield to a full analysis and I

think it stands as a complete vindication of the new hypothesis. When we have here a case of only 85 male producing units to offset 577 female producing units is it a matter of wonderment that an excess of 110% female births for 3 years is developed?

387. The state of West Virginia is an exceedingly heavy producer of coal and conditions in Nicholas county were noted in the chapter on Economic Relativity. From statistics the counties of McDowell, Fayette, Logan, Raleigh, Marion and Kanawha are indicated as the highest six in coal production during 1912,-13,-14 and 1915. For the four years McDowell county, with upwards of 14,000,000 tons of coal annually and but very little coke, produced an average of 21% excess male births. Marion county, against its heavy coal production, has an offset in great activities in gas and oil well operations. As in the case of Marion county, so in Kanawha, heavy gas and oil operations tend to neutralize the influence of a heavy coal production. There remain four counties in which well drilling does not counterbalance coal mining; these are Fayette, McDowell, Logan, and Raleigh. The last two named combined, for the four years produced 10 1-10% of excess males while of the four counties Fayette alone fell to a quadrennial average male sex ratio of 1.009. Logan county alone averaged 23 7-10% of excess males and in 1916 the male sex ratio for that county rose to 36%. (1)

388. Every possible effort was made to ascertain the conditions which underlay the failure in Fayette county but no facts of any sort were available. Fayette county is situated high up in the mountains and it is possible that seasonal interruptions in railroading had something to do with the volume of coal production which would otherwise have been heavier with a more favorable effect on the male sex ratio.

389. So we could continue ad infinitum or until we had exhausted every unit of territory on earth which affords birth returns; but in the face of the facts which

Note (1) The birth figures cover 1913 to 1916 inclusive.

have been presented and the inevitable conclusions which have been drawn from them it is obvious that such a course would be not only wearisome but needless as well.

390. A test was conducted at the office of the Detroit, Michigan Board of Health to determine the value of occupation alone as an index of what the sex of the offspring will be. The registrar read to me from a list of the returns for one day the occupation of the father upon which I gave my judgment as to the sex of the child. There was a total of 79 returns for the particular day. Of the group which I set aside as males there were in fact 31 males and 16 females; and of those which I had called females there were 20 females and 12 males. So by this method of classifying the sex of the child I was successful in 51 out of 79 cases. The discrepancy was due partly to the fact that in some instances I was unable to determine from the title of the occupation alone whether the father worked indoors or out, the essential element in working towards a determination upon the basis of occupation alone. The same test was repeated with the birth returns of the following day with substantially the same results.

CHAPTER XIV

Heat and Moisture versus Light

391. To the observing reader a draft of issues such as the title of this chapter suggests would be almost superfluous. Nevertheless it may be of some value to summarize the conclusions which appear to be warranted.

392. Much has been done heretofore, as has been previously mentioned, to show that sex variability has a correlative in the question of water in the ovum, but no authority, apparently, has ever discussed any phenomena involving the question of hydration of the spermatozoa. While doubtless the human ovum, as in other higher mammals, varies with its moisture content, the question as to what that moisture value may be is not particularly related to the question of moisture in the individual's environment.

393. The greenhouse is an exceedingly moist environment and of the same nature is the coal mine and the copper mine. Out of the greenhouse comes a majority of female births, while from the mine comes a heavy majority of male births. In each case the father's environment is one of moisture; so it follows that moisture as an environmental influence is wholly discounted.

394. In the case of agricultural districts in which, as has been shown, an excess of female births responds to an excess of rainfall, there is no basic cause operating in rainfall. Rainfall merely enforces more housing preferentially for the mothers, and housing, in turn, shelters them from sunlight. Between the greenhouse and the mine, moisture does not afford us a variable factor, but light does. The contrast is similar between the effects of the stone quarry, which is always a damp environment, and the mine, which is also damp. We were forced to recognize the stone quarry as a producer of female births.

395. Exactly the same contrast in the matter of heat exists between greenhouse and stone quarry on the one hand, and mine and steel mill on the other. In all four of these environments the heat factor is high, nevertheless the factories and steel mills of Latrobe, Pa., and the coal mines of McDowell County, W. Va., produce an unusually high proportion of male births. Heat here also fails to answer: for these four environments, conditions of light and darkness are the antithetical variables. Thus heat and moisture as environmental factors, in the human case, are discredited. Light alone remains.

CHAPTER XV.

Conclusion

396. There is no sane demand for quantity in population:—in fact, in common with quite a number of unpopular pioneer scientific pronouncements, the Malthusian hypothesis has escaped its most relentless critics and stands out today the unparallelled challenge of Human destiny. The tinselled lure of synthetic foods but compounds the biological cul-de-sac into which an insufferable, intellectual, ethical, and emotional development has thrust the race. The prime demand is for offspring of better quality, which is one of the ends incidental to this discourse and which will have been advanced if I shall have succeeded in stimulating the fullest of researches into the phenomenon of sex stresses in the infant's system. A child born into the world is poorly equipped for life's struggle if such a condition interferes with proper nervous functioning.

397. It is true that there are few people who live and move and have their being by any set rule or definite plan, but once we have established the definite results upon the child of certain measures of previous parental relation to sunlight, some compelling responsibilities may come to be charged to would-be parents. At present I am not yet ready to offer evidence on the point but I consider it more than probable that at least some forms of idiocy are due to pre-natal sunstroke. It cannot be denied that the human race does, in many instances, expose itself more mercilessly than any other important species to the blistering rays of the summer sun, yet at the same time it possesses the most elaborate systems of housing. We find it true that among the lower species the brain power and brain size as well, lessens as we approach those species which subject themselves constantly to the sun's light; for example, the ostrich, the camel, the rattle snake or the gila monster. The influence of light is

always intimately related to the development of the brain and nerve systems.

398. The values involved in the solution of the problem of sex control are not entirely sentimental. There are occupational considerations which are of real consequence. The farmer's first child or two, should by all means be male. Who is it has not expressed sympathy for the farmer advancing into his forties with a houseful of "daughters only"? There are numerous occupations in which dependable control becomes desirable. The question of sex determination also projects its shadow across the field of jurisprudence in which there are cases of various kinds demanding the determination of parenthood.

399. The value of a definite method for controlling the issue of sex in live stock is of more immediate and pressing importance than for humanity. The solution of the problem for man should quickly give us admission to the solution of the case for other mammals. Such was the belief readily expressed by Dr. L. C. Pelton, Washington State Veterinarian, in 1923.

HOUSING

400. Certain adverse effects of too much sunlight have been referred to. What shall we say of too much housing?

401. We have long marvelled at the wonderful civilizations of past ages, the mute witnesses of which are the pyramids of Egypt, the Acropolis at Athens, the vast and ponderous ruins that, from the islands of the eastern Mediterranean all across western Asia to the Indian Ocean, lie buried or scattered in endless confusion: the gigantic monoliths and edifices without number which are now in ruins and buried in the rank vegetation of Mexico and Central America; on the other hand, China, Japan and India with their teeming millions living in huts of thatch, palm and bamboo, come forward, live, flourishing, and ponderous, though hoary with age

from the depths of unfathomed antiquity. Tell us now,—can a nation live forever and still persist in housing itself in heavy opaque materials? True, the housed peoples of remotest antiquity were the conquerors, but where is the housed nation which in turn, did not finally pay the price? It is not strange that the history of past peoples reveals their perpetuity as being in inverse proportion to the staunchness of their architecture?

402. At the outbreak of the war in 1914 Germany had reached a point at which almost every family in the nation was housed in opaque materials such as stone, brick, tile, concrete, etc. Margaret Sanger, following a post-war trip to Europe, was quoted as having received confessions from German science that the multiplication of the race was basic to the war. The multiplication of the yellow and brown races bears no comparison to the speed at which the housed white race is increasing. Prior to 1492 the red man had held full sway on the North American continent for thousands of years so far as we know, still he numbered only about half a million at the time of discovery. Consider the expansion of the white race since that time! It is not within the power of diplomats and their paper agreements to prevent for long the white nations from flying at each other's throats while their housing in opaque materials raises their rate of multiplication to the speed limit.

403. It seems past dispute that the environment of the school house is abnormal for the teacher, from a sex standpoint. It is any more nearly normal for the pupils? When the true significance of these phenomena comes finally to be acknowledged there will be radical changes in the architecture of educational systems. We shall in the time to come, build only a longitudinal tier of rooms east and west so that each will receive the full daily sweep of the sun.

WAR AND THE BIRTH RATE

404. The only immediate effect of war upon the birth rate of that nation which engages in the fighting is to reduce the number of births. In 1914 the births for

England and Wales were 881,890; in 1915, 814,614; in 1916, 780,520; in 1917, 668,346. Upon the sex ratio, war has no immediate effect either physical of psychological. In the past the statement has been repeated an infinite number of times that war produces a surplus of boy babies. This is a grave inaccuracy. War stimulates certain industries and these industries react upon the sex ratio according to their relative characteristics.

405. If we refer to machine shops making cannon and shells we encounter an unusual excess of male births, but at the same time if we turn to railroading engaged, under great urgency, in the transportation of those munitions, we find a disproportion of female births.

406. It was previously noted in connection with PLATE 31 that Indianapolis, Indiana moved over to an actual excess of female births in 1917 for the first time in at least ten years. The same is not true of Muncie, Indiana, which moved to a notable excess of male births in 1917.

407. The proper effects of war itself must be looked for in the case of the offspring of soldiers shortly after their return from the scenes of battle and not before. (1) I composed an estimate in the case of the army returned from France that if 700,000 of these men mated after returning, and if 650,000 births resulted, spread out over the period between February 11, 1920 and September 30, 1921, it would result in altering the sex of perhaps about 8 infants in each 10,000 births for the entire population of the country. And when this is compounded with the other and antithetical results of enormous volumes of housed industrials of both sexes engaged in war production, the gross results of the great war in terms of birth sex alteration would indeed be inscrutable, and well nigh negligible.

408. In drawing to a close this effort, I feel that it will not have been vain if its net result is to point out to those who are interested in the problem, that category of phenomena wherein undoubtedly the answer lies. True

progress is attained only by the joint labors of all; hence I leave with the reader the Chromo-Solar Hypothesis of sex, basing it upon such findings as I have been able to unearth, and herewith offering and inviting him to fully criticise, or to re-interpret wherein he may deem them to be in error. Once the bars are removed and admittance is gained to the fields where the truth exists, there will not be lacking those who can develop potent details and perfect the practical. What I have given has not been with any consciousness of bias, and I shall hail with delight all possible progress in this field of research regardless of who the gleaners may be.

Note (1) When Dr. McClure, Surgeon-in-Chief of the Henry Ford Hospital in Detroit, Michigan, told me in the spring of 1920 of his services in France with the army, and of that of one of his colleagues, and informed me that daughters had been born to them both since coming home, he urged me to give my interpretation then; I confess to evasion of his question, desiring and purposing to answer later thus with a complete work.

Appendix

The indications of and evidences for iso-gametism in homo had already been penned when the report of a stillbirth in the family of a relative reminded me that, incidentally, in the birth statistics for Red Jacket, Michigan, a village wholly dependent upon the Calumet and Hecla copper mine, I had been supplied with the figures for stillbirths also.

The copper production curve as shown on PLATE 33 will be recognized as a duplicate of that on PLATE 26. By plotting the curve of stillbirths in percentages we have the result shown in the lower curve, and by superposition the parallel becomes obvious.

What then develops upon the strength of the fact that high copper production induces a high percentage of infants born dead, and that a decrease in copper production occasions a decrease in stillbirths? This is the equivalent of asserting that in the mining industry a child conceived when the father is idle has a better chance for life than one conceived when the father is at work.

It would certainly seem from this development, that the theory of sex stresses in combat within the child's system is advanced far beyond the status of a mathematical postulate. Reading between the lines, we see the father's sex potential rising, while in the protection of the mine, to a point at par with that of the mother in the protection of the home, and the consequent thrusting into the child's anatomy of the stresses thus generated.

The logical reflex of this is to affirm afresh the complete segregation of the two gametes in the human species. But these are not the only considerations brought into question by this parallel of copper and stillbirths, for here is produced a complete revolution in our concept of the relation of the condition of the mother to the welfare of the unborn child. And those who insist that the "welfare" of the child-to-be depends almost wholly upon the

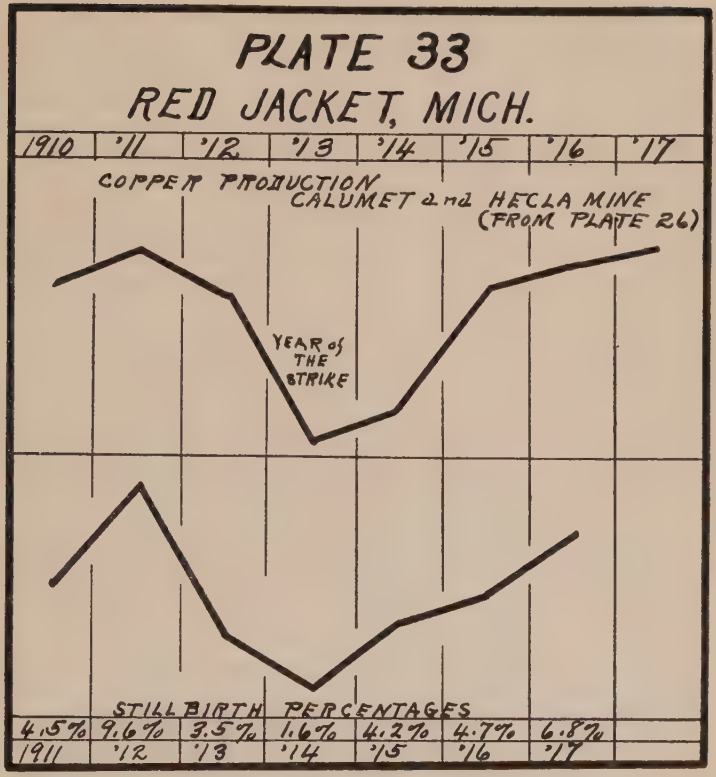


PLATE 33
RED JACKET, MICH.
1910 '11 '12 '13 '14 '15 '16 '17
COPPER PRODUCTION
CALUMET and HECLA MINE
(FROM PLATE 26)
YEAR of THE STRIKE
STILL BIRTH PERCENTAGES
4.5% 9.6% 3.5% 1.6% 4.2% 4.7% 6.8%
1911 '12 '13 '14 '15 '16 '17

mother's peace of mind, her proper nourishment, and well being, etc., must here face the negating fact that the mothers are producing a higher percentage of their offspring alive out of a period of industrial depression, worry and shortened rations.

In this case for Red Jacket, Michigan, a rather obscure question arises as to why Sex Ratios (Plate 26) should react within the year of the corresponding copper point, whereas the stillbirths react, apparently, in the year following the copper point. It is most probable, however, that monthly plottings in both cases would show Sex Ratios reacting in 9, 10 or 11 months and stillbirths reacting in 13- or 14-month periods.

A sharp increase in male births among emigrants and colonists in new regions, has long been an acknowledged fact. This, of course, is due to more exposure and to a more radical change for the mothers than for the fathers in such cases. A removal of the family from one city to another,—even though the father's occupation is neither changed nor unduly interrupted—often results in a change in births favoring male production. Corroborative testimony of a number of my acquaintances tends strongly to uphold this observation.

Doncaster in his work of 1914 refers to Phillips' experiments with ducks, wherein Phillips reports crossing a large male of one species with a small female of another species. A heavy male preponderance in offspring resulted. Phillips suggested that this was related to the excessive weight of the male. Here at once a sharp and critical conflict arises with several lines of "cleavage." If Phillips' experiment with ducks is repeated a few times and the same results ensue, then the theory of heterogametism for birds (females producing both male and female gametes) will be utterly discarded,—for it will show that the male bird transmits only maleness, and it will serve the still more important function of proving the total unreliability of all microscopic observations made on cyto-gamētic processes.

A friend has just cited a parallel for Phillips' case. In this instance a large white leghorn rooster mated with a small black minorca hen with a result of about 85% males in the brood issuing. The chromatic factor is also present here.

The foetal heart beat rate in homo was, only a few years ago, hailed as an index to the sex of the unborn. Later and more careful tests have broken this hypothesis completely.

At the convention in Cincinnati, Ohio, (spring of 1924) of the American Association for the Advancement of Science, Dr. Oscar Riddle announced the observation of the certain reversal of sex in the adult pigeon, and the

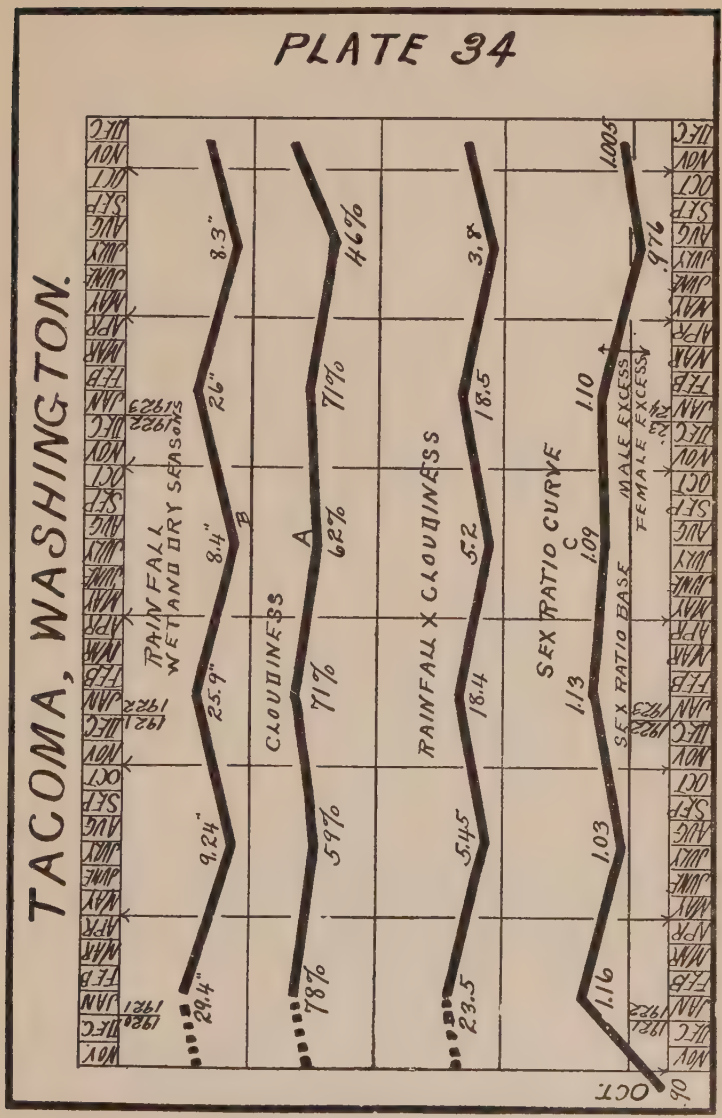


PLATE 34
TACOMA, WASHINGTON.
RAINFALL
WET AND DRY SEASONS
CLOUDINESS
RAINFALL X CLOUDINESS
SEX RATIO CURVE
SEX RATIO BASE
MALE EXCESS
FEMALE EXCESS
A
B
C
29.4"
9.24"
25.9"
8.4"
26"
8.3"
78%
59%
71%
62%
71%
46%
23.5
5.45
18.4
5.2
18.5
3.8
1.16
1.03
1.13
1.09
1.10
1.005
.976
JAN 1921
1922
1923
OCT

report also comes of the power upon the part of the oyster to reverse its sex,—and this seems to occur—not only once—but several times in a year. These phenomena, however, will not affect the view that the sex of Homo is fixed at the moment of gametic union, and is unalterable thereafter: and neither will the occasional appearance of hermaphroditic forms in Homo, affect the case:—these, too, have a foundation based in the gametic conjugation, and are not the result of varying influences at work upon the embryo.

The final exigencies involving the first production of this work on Puget Sound evoked the suggestion that I present a Plate for some locality near at hand. Tacoma, Washington yielded, splendidly, Plate 34. Here are shown the results of the only figures examined. This was plotted March 3rd 1925 and included all birth returns available at that time—down to Jan. 1, 1925. Rainfall, cloudiness, Rainfall X cloudiness and sex ratios are depicted, based on a division into 6 months wet season, and 6 months dry. A period of 3 years is covered, and the synchronism is 100% perfect, reading, as for Indianapolis, Ind., "Low compound and females, high compound and males."

Note the unusually high male sex ratio at "C" as compared with the disproportionately low rainfall at B. Here sustained cloudiness at "A" steps in as the factor responsible for the high altitude at "C".

Were I to admit the theory of heterogametism for any of our common domestic animals, then it would be futile for me to add any word that the live stock man might require, but personally, I very seriously doubt that any but iso-gametic functions exist among any species of animals that are of any consequence to us.

With a view to lessening the amount of experimental work that the live stock expert may feel impelled to do I would first suggest that only animals of solid color be used; All black, all white, all red etc. As has been pointed out for Homo, when the color scheme for the two mates cancel, we have then to manipulate only two factors i. e.

weight and exposure, balancing also the weight if possible. It should then only be necessary to ascertain the excess amount of exposure for either of the two.

We have a most stubborn set of circumstances with which to deal in the case of matings with a male retained for regular and specific service. In such a case his sex potential tends constantly high because of spermatozoa discharged and generated freshly every day or two, or possibly oftener. This could be offset to some extent (female offspring being demanded) by bringing up at each succeeding service a female of stronger color or of greater weight than the preceding.

The sex potential capacity of the white animal will probably be found intermediate between the black and red. Because of monochromatic conditions obtaining largely among sheep, the chromatic factor is rendered simpler, but on the other hand, the fertilizing of an entire flock of ewes within a few hours by the same ram brings up a refractory phase.

Let me suggest the division of the ewes into, say, a half dozen groups, if possible, each group composed of individuals whose weights are approximately equal, but where light weights compose the first group and heavy weights the last group etc. Admitting the ram (who has had rest) first to the light weight group, let him be moved successively toward the heavy weight groups. This should develop a heavier percentage of females for the total. Nor is it to be considered improbable that successively shearing the ram, reducing his coat by degrees, with two or three days of excess exposure between his successive admissions to the several groups, will tend to increase still more the proportion of female births.

Glossary

A

Acceleration ---------- a speeding up.
Achromatic ---------- having no color.
Actinic rays ---------- light rays which cause chemical changes.
Anaemic ---------- a condition due to a shortage or paleness of the blood.
Antithetical ---------- conditions or factors whose characteristics are exactly opposed to each other.
Arachnids ---------- spiders, crabs.
Asexual ---------- condition of a parent who does not supply any sex characteristic to offspring, or the condition of an individual or of a germ not having sex.
Asynchronous ---------- not acting in step nor in unison.

B

Bi-lateral ---------- having two sides.
Bio-chemical ---------- chemical reactions and expressions particularly involved in, or produced by the life processes in organic cells and tissues.
Biology ---------- the science, or study of life processes and principles.
Bi-Sexuality ---------- the characteristic of a species having separately functioned male and female individuals.

C

Chromatic ---------- having color chacteristics.
Chromo-circulatory ---- related to the "Blood-color".
Chromo-epidermal ----- related to the "Skin-color".

Chromosomes ——— "Color-bodies"—peculiar entities developed in the organic cell preparatory to its division and multiplication.

Conjugation ——— a uniting.

Copulation ——— the union of the two sexes in the reproductive function.

Crookes tube ——— a sealed glass container with electrodes of special construction for the generation of X-Rays by the application of high-frequency electricity.

Cyto-gametic ——— related to the internal structure and functions of the germ cell.

Cytology ——— the study of the internal structure and functions of the individual organic cell.

D

Deterrent ——— a preventive.

E

Empirical ——— experimental.

F

Fatalists ——— those who hold that the course of events or the nature of a thing is fixed and not discoverable nor consciously alterable.

G

Gamete ——— an original, unconjugated germ cell, either male or female.

Gametic ——— pertaining to an original germ cell.

Gametic-union ——— the union of two germ cells (male and female) for the production of a new individual.

Gameto-genetic tissue—tissue in which original germ cells are generated.

Gestation ——— the period (in mammals) of the development of the embryo from fertilization to birth.

H

Heterogametic ——— condition of a parent who has the power of developing both male and female germs.

Homo (Latin) ——— Man,—the Human species.

Hydration ——— dissolved by water; thinned by the addition of water; the acquisition of a water content.

Hypothesis ——— a theory.

I

"In Situ" (Latin) ——— resting in its original, normal or proper place.

Iso-variables ——— two or more variable quantities or factors whose variations are mutually similar.

Iso-gametic ——— condition of a parent who supplies reproductive germs of his or her own sex only.

L

Lag ——— a slowing down.

M

Marginal ——— tributary or accessory. Not basic.

Menstruation ——— the automatic cleansing discharge from the generative tract of the female occurring every 28 days.

Metabolism ——— the bio-chemical processes in the life cycle of cells.

Monochromatic ——— having only one color.
Monosexuality ——— the power to transmit the characteristics of only one sex.

N

Nasal ——— pertaining to the nose.

O

Opportune ——— not basic nor arbitrary but dependent upon the fortuitous concurrence of other factors or circumstances.
Ovariectomy ——— the operation involving the removal of an ovary.
Ovum ——— an egg: the female gamete.

P

"Per se" (Latin) ——— "In and of itself."
Polychromatic ——— having more than one color.
Postulate ——— a logical necessity or requirement; a self-evident proposition.
Predeterminists ——— see Fatalists.
Primates ——— animals of first rank;—Man, Chimpanzee, Orang-Outan, Gibbon, Gorilla.
Pulmonary ——— pertaining to the lungs.

R

Rotifer ——— a tiny insect (some species are quite microscopic).

S

Sex-Potential ——— the preferential capacity of the individual to transmit his or her own sex to offspring.
Sex-Ratio ——— the proportion of one sex to the other in the total number of births.

Spermatozoa ----------germs supplied by the father.
Somatic ----------pertaining to the body.
Synchronized ----------placed in step.
Synchronous ----------occurring at the same time; with the same frequency; keeping in step.

T

Testicle ----------the male generative gland and sperm repository.

U

Uterus ----------womb;—female repository for the developing embryo.

V

Vertebrates ----------animals which possess backbones.

Z

Zygote ----------the group of primary cells, after fertilization developing into an embryo.

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CHRONOLOGY

Concept and apprehension of first clues spring of 1916.

Canvasses of families and cases Philadelphia, Pa., 1916: Kokomo, Ind. 1916-17: Detroit, Mich. miscellaneous and Greenhouse canvasses 1917-18.

First graphs plotted May, 1917, showing sex ratios in births reacting to cloudiness.

First graphs plotted 1919 showing sex ratios in births reacting to rainfall.

First published remarks in the American Journal of Clinical Medicine (Chicago) Sept., 1919.

Second public statements in Detroit Times (Detroit, Mich.) Sept. 30th, 1919 (Reported by A. F. Munroe).

First full disclosure of basic principles and of SUN-LIGHT as Prime Determinant in three public lectures Oct. 7-8-9, 1919, I. O. O. F. Hall, 129 E Bethune St., Detroit, Mich. (Vide publication and reference to SUN-LIGHT, Detroit Times, Oct. 8th, 1919).

Complete lecture before Muskegon County Medical Association, Muskegon, Mich., latter part of April, 1920.

Greenhouse canvass Muskegon, Mich., May 1920.

Two public lectures at Women's Club House, Muskegon, Mich., May 16 and 18, 1920, with full disclosures of basic principles. (Vide display advertising Muskegon Chronicle May 15-17, 1920.)

Greenhouse canvass Minneapolis, Minn., summer 1920.

Complete lecture Fairview Hospital, Minneapolis, Minn., Aug. 19, 1920.

Public lecture at Redmond, Washington, March 20, 1921.

Revisions of Manuscript and canvass of publishers.

Rainfall parallel plotted for Tacoma, Washington, March, 1925.

2.Am.223.
The cause and control of sex in1926
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